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Managing Editors: M. Beckmann and W. Krelle

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Proceedings, Gouvieux, France, 1981

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Foreword

Those familiar with input-output analysis know well that compilation of input-output tables is a difficult statistical work. The very first input-output tables (e.g. such as those for the United States economy in 1919 and 1929 or for the Federal Republic of Germany in the fifties) were the results of applied economic research. But soon after, official statistical bodies, who understood that input-output tables consistent with national accounts can very much improve the quality of economic statistics, started systematic work in this field.

It was also obvious that international exchange of experience can be useful. The two main international fora in which discussion of input-output compilation took place were the international input-output conferences and United Nations bodies.

Already at the First International Conference on Input-Output Techniques (Driebergen 1950) several authors analysed the relations between input-output tables and national accounts. The topic was also on the programme of the Second Conference (Varenna 1954). At the Third Conference (Geneva 1961) standardization of input-output statistics was a topic of a panel discussion of eight experts. The relevant papers, which are still of interest, can be found in published conference proceedings.

The most active organisations among the UN bodies were the Conference of European Statisticians of the Economic Commission for Europe and the UN Statistical Office. In 1955 a working group was convened to review the basic aspects of the input-output approach to interindustry relationships, to bring together information on the experience of various national statistical offices and to examine the feasibility of drawing up international standards in this field. The results were summarized in an article published in 1956. Another working group met in 1964 and its conclusions were published in the same year. Evaluation of national experience in input-output compilation (and use) was the basis for the United Nations manual on input-output tables and analysis, first published in 1966 and revised in 1973. In 1968 input-output analysis became an integral part of the United Nations System of National Accounts.

In the early seventies it thus seemed that most problems of statistical compilation of input-output tables were solved. The topic was not on the programme of international input-output conferences (in Geneva in 1970 and in Vienna 1974) and was also given little attention by UN bodies. But at the Seventh International Conference (Innsbruck 1979), a call for a revival of discussion of input-output compilation questions came from the floor. The International Association for Research on Income and Wealth then agreed to put an input-output session on the programme of its Seventeeth General Conference held in 1981 in Montvillargene in France. I had the honour to organise the session. Soon after the announcement of the meeting, I was surprised by the large number of contributions offered. Since only a few of them could be accommodated in the Association's journal the Review of Income and Wealth, I looked for a publisher of the proceedings of the session, and found Springer Verlag, who was willing to publish a selection of papers on input-output compilation. Facing the difficulty of choice, I decided to include into the conference proceedings only studies on national tables and to leave out papers dealing with interregional input-output tables or with input-output analysis. The papers selected for the publication were revised and retyped by their authors and photocopied by the publisher.

The reader will find in the book the accumulated experience of many countries, but with some notable exceptions. There is no contribution by the Statistical Office of the European Communities, which compiles series of internationally standardized tables of its member countries. Missing also are contributions on the long experience of the United States in input-output compilation or about the advanced Japanese system of input-output statistics. Not are there contributions coming directly from developing countries with good input-output statistics, such as India or the Republic of Korea, not from centrally planned economies (for example, a report from Hungary would have been of great interest).

But in spite of such omissions, professional statisticians and economic model builders will find in the book a good presentation of the state of art in input-output compilation. One can see how input-output statistics are being integrated into national accounts and how they can improve their quality. But vast data systems can be mastered only by efficient computers and rational organization of data storage. Open methodological questions seem to be concentrated in two

fields; in pricing (for example, valuation at approximate basic values, treatment of value added tax or construction of tables at constant prices) and in the separation of flows of domestic origin from imported flows.

At the end of this brief introduction I would like to thank to all authors, whose contributions at Montvillargene allowed a useful exchange of views. I would also like to thank the discussants of the papers, (represented in this volume by Mr. O.Aukrust), whose opening remarks concentrated attention on the most important topics and stimulated the discussion.

Dr.Jiri Skolka
Austrian Institute for
Economic Research

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List of Contents

Part I.

Systems of Input-Output Statistics

PROBLEMS OF INPUT-OUTPUT ACCOUNTING

by

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Director of Research
the Central Bureau of Statistics of Norway

What follows is based on notes originally prepared when, at the 1981 IARIW conference, I was discussant of two papers included in part I of the present volume, namely the papers by Mr. Lal, Canada, and Messrs. van Tuinen, Algera and Mantelaers, the Netherlands. The notes have been redrafted at the invitation of the Editor so as to serve as a general introduction to part I of the volume.

Planning I-O Work

1. When planning I-O work in a country a balance will have to be struck between a number of considerations. The most important ones may be listed as follows:

a) What are the expected analytical uses to be made of the I-O data? Do we intend them to serve primarily as a data source for

- compilation of impact tables ("inverted" tables)?
- construction of macro-economic models?
- structural analysis at industry levels?

b) What are the expected statistical users of the I-O data? In particular,

- do we intend to use I-O accounting as a means to controlling the quality of primary statistics?
- what relationship do we intend the I-O table to have to the national accounts?

c) What resources are available:

- what kind of primary statistics is at hand?
- what amount of human resources can be spared for the project?
- is automation feasible?

2. Having the above consideration in mind, what should be the aim of a country which was to start I-O work today with unlimited resources at her disposal? Ideally, the country might plan for a set of I-O tables with the following properties:

- The tables would be industry-commodity tables, computed at constant as well as current prices.
- The tables would be fully consistent with the national accounts.
- The tables would be constructed annually to provide time series, consistent over time and prepared with short time lags.

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- Thetables would be prepared in great detail so as to allow for structural analysis and for control with the quality of primary statistics.
- The system would be flexible, allowing for easy re-arrangements of flows and for aggregation, to meet the needs of modelbuilders; such a combination of detail and flexibility would require automation.

How do country practices measure up against this ideal?

Examination of the Practices of Selected Countries

3. In part I of this volume we have papers from four countries with long traditions in I-O work. Indeed, three of them (Denmark, The Netherlands and Norway) can be counted among the pioneers in the field; in these countries I-O data have existed in some shape or other for more than 30 years. Canada came later; here the first I-O table, for 1961, was published in 1968. In all four countries I-O data are prepared today as a routine, and on an annual basis. However, partly due to historical circumstances, there are noteworthy differences amongst them with respect to methodology and presentation.

4. In Canada, I-O work appears to have been started as a separate undertaking only indirectly related to national accounting, but with a clear understanding of the usefulness of I-O statistics for economic analysis. Industry-commodity tables at various aggregation levels are published annually, including impact tables. Consequently, Canadian I-O work comes a long way towards meeting the theoretical requirements set out above. However, according to the authors of the Canadian paper,

- there does not exist complete conceptual and statistical consistency with the national accounts
- There is not enough commodity detail for deflation purposes; however, this will be corrected at the next review of this work.

5. In Denmark, the Netherlands and Norway, in contrast, I-O work was initiated originally as an aid in compiling national accounts. As a result, these countries have available annual I-O statistics in current and (in Denmark and Norway only) fixed prices, which are completely consistent with the national accounts. This is typical of countries which have chosen to set up their national accounts by "the commodity flow approach".

6. The three countries differ considerably, however, with respect to the detailedness of their data and the way in which data are made available to analysts. The Danish and Norwegian data are available in very great detail on tape, while facilities exist for easy rearrangement and aggregation. The Dutch data are available in rather aggregated form in print only; according to the authors of the Dutch paper there is little flexibility in the system due to lack of automation. However,

these are shortcomings which Dutch statisticians are now working hard to overcome, in respønse to new demands from users of I-O statistics.

7. By studying the papers of part I one will se that country practices differ also in many other respects, i.g. in methods of valuation, in the routing of imports, in the treatment of trade and transport margins, and in the use of automation. From the many issues raised in the Canadian, Danish, Dutch and Norwegian papers I shall select for comment three which I consider to be of general interest, namely,

- questions of aggregation in I-O work,
- problems of deflation,
- problems of comparability over time (continuity).

On aggregation

8. There is agreement by all experts that I-O accounting should start at a very detailed industry and commodity level. Three obvious advantages may be listed:

- better use of original data and more scope for consistency checks,
- improved deflation,
- provision of a good information base for analyses at the industry/commodity level.

9. What is the position with respect to industry and commodity detail in various countries?

- Canada, at the most detailed level, distinguishes 191 industries and 595 commodities. It seems to be the opinion of the author of the Canadian paper that this is not enough and that the commodity classification should be further disaggregated.
- The Dutch authors state that calculations in the Netherlands are carried out with "some thousands of commodity groups and many hundreds of industry groups". Published tables at present are much smaller, however. Future plans are for preparing tables with 1 000 commodity groups and 200 industry groups, and even these dimensions may be increased further.
- Norway distinguishes about 1 750 commodities and 190 industries.
- Denmark distinguishes 4 000 commodities and about 120 industries.

10. Such detail is, of course, too much for publication. Hence the question arises: To what level should we aggregate? The answer must depend to some extent on the use to be made of I-O statistics. In my view:

- To the extent that we are interested in structural analyses at the industry level, or in studying the impact of exogenous events on indvidual industries, we will have to work with a large number of industries, perhaps something within the 100-200 range. In the Netherlands it appears that users of I-O data for industrial analysis have suggested that an aggregation level of 250 industry groups be suitable.

- To the extent that the data are to be used primarily for the construction of macro-economic models, the answer is less clear. Increasing the number of industries and commodities in a model may perhaps improve the stability of coefficients. Against this must be set the fact that a large model is cumbersome to programme, to modify, and to run. On the basis of Norwegian experiences it is not even obvious that the quality of estimates which you get from a very disaggregated model (say, 150 industries) are much superior to estimates obtained by means of a medium-sized or smaller model (40 industries). A least this may hold true when you are mainly interested in macro-economic analysis and do not particularly care what happens in individual industries.

11. The upshot of these considerations probably should be a plea for flexibility: Ideally the basic data should be available in very great detail, and we should have facilities for easy retrieval at any aggregation level. This will not be possible without automation. If flexibility is not available the Canadian example offers a possible substitute: To make I-O data available, in print, at alternative aggregation levels.

On deflation

12. There seems to be much agreement in theory as to the methods to be used when estimating I-O tables in constant prices: Apply double deflation to the most detailed table, expressed at producers' prices (or approximate basic values).

13. While the principle is simple a number of problems are usually encountered in practice. The Canadian paper gives a good survey of these. I have two minor comments:

- The paper seems to argue that, in general, a complete reconciliation of the indexes of GDP by industry of the national accounts with corresponding estimates in the I-O table will not be possible. I do not agree. I can see that there are practical problems here in countries where national accounts and I-O lead separate lives. However, where the I-O accounts are integrated parts of the national accounts (such as in Denmark, the Netherlands and Norway) this is not the case: The deflated aggregates from the I-O accounts are simply accepted for the national accounts as well.
- The paper contains an interesting discussion of the deflation of trade margins: The solution suggested (to make the margin rate at constant prices equal the margin rate at current prices) is ingenious and has much appeal.

14. There is one further problem with deflation which is touched upon in the Canadian paper and discussed at great length in the Dutch paper. This is the following: We will usually have to shift base year at intervals for our fixed-price estimates. When we do this we will soon discover that the chaining of estimates, available at different price sets for different periods of time, is by no means a simple matter. The difficulty arises because, in the words of the Canadian paper, "chained indexes are not additive, and this non-additivity gives rise to adjusting

entries ....". The issues are technically rather intricate and I shall not go into them , except to say that we here have problems of estimation as well as of presentation. These are problems which all countries with current price data for long periods will have to be well aware of.

On continuity

15. As a final point I will take up a problem which is discussed at various places in the Dutch paper. We all know that from time to time we discover that the level of some flow or other in the I-O table has been wrongly estimated, either because we get newer and better statistical information or because we learn that we have made an error. What do we then do? Two alternative courses are open to us:

- We may correct errors whenever we discover them. The unfortunate consequence of this will be to introduce breaks in some series, and figures for one year will no longer be comparable with corresponding figures for earlier years.
- Alternatively, we may choose to accept the wrong level and extrapolate as best we can from there, thus maintaining comparability over time.

Of course, this problem is not specific for I-O tables. It applies equally to national accounting work in general.

16. It seems obvious to me that we cannot simply correct all errors in levels as soon as we discover them. This would mean either that we should have to give up completely having time series comparable over time, or that we would have to carry through backward revisions of the complete system more or less every year. The latter is clearly something which we do not have the resources to do.

17. The "solution" suggested in the Dutch paper is to give priority to comparability over time, and to accept known errors of levels as something which we will have to live with for lenghty periods of time.

18. This is also the policy followed in Norway. However, we find revisions at 5-year intervals (as suggested by the Dutch) to be too frequent. A complete revision of the national accounts, implying backward estimates of all I-O data and other national accounts data for perhaps 20-30 years or more in current and constant prices, is an extremely time-consuming and costly operation. Admittedly, such revisions cannot be completely avoided if our national accounts data are to maintain comparability over time. But a frequency of revision of, say, once in 10-12 years may be a more realistic goal than the 5 years intervals hinted at in the Dutch paper.

19. However, this may change if and when we get computers and efficient programmes which will allow the adjustment of one number to be traced through the complete system of national accounts at the press of a button. In Norway, at least, I fear that the time when this will happen may still be years ahead.

COMPILATION OF INPUT-OUTPUT TABLES: CANADA*

by

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Introduction

The Input-Output Division of Statistics Canada prepares and publishes annual Input-Output Tables for Canada in both current and constant prices. The latest tables refer to the year 1977 and with this there is a completely consistent historical series of annual tables from 1961.

The accounting framework of the Canadian tables given in chart 1 bears a close relationship to the one described in the United Nations report, A System of National Accounts[1]. The inputs and outputs of industries are presented in separate tables; both inputs and outputs are classified by commodity. Commodities are clearly distinguished from industries, the number of commodities exceeding the number of industries. The Canadian Input-Output Tables are rectangular rather than square. The commodity-industry format has important advantages over the traditional inter-industry square format: (i) it admits as much detail as is available in the basic economic records; (ii) the meaning of each entry is straightforward because observed transactions are not combined with fictitious transfers and (iii) it provides a statistical audit of the consistency, integrity and comprehensiveness of economic statistics. The last advantage assumes particular importance when Input-Output statistics are developed in a central statistical organization like Statistics Canada.

Canada is one of the pioneering countries in both the theoretical and empirical development of rectangular input-output tables, a development pursued by practitioners in Statistics Canada and in other institutes. Preliminary Input-Output Tables for the year 1961 were published by Statistics Canada in 1969 in two volumes: <u>Input-Output Structure of the Canadian Economy, 1961; Vol. I</u> (catalogue 15-501), <u>Vol. II</u> (catalogue 15-502). In these volumes a comprehensive description of the detailed accounting framework, analytic uses, the published tables, classification systems

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* The opinions expressed in this paper are those of the author and are not to be attributed to Statistics Canada.

(1) A System of National Accounts, Studies in Methods, Series F, No. 2 Rev. 3 United Nations, New York, 1968.

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CHART I

The Accounting Framework of Canadian Input-Output Tables

	Commodities	Industries	Final demand categories									Total
			PE	FCF	VPCW	VPCA	GGCE	X_D	X_R	Less M	Less GR	
Commodities		U	F									q
Industries	V											g
Commodity indirect taxes Other indirect taxes Less subsidies Wages and salaries Supplementary labour income Net income of Unincorporated business Other operating surplus		YI	YF									n
Total	q′	g′	e′									

Final Demand Categories

PE – Personal expenditure on goods and services
FCF – Fixed capital formation, business and government
VPCW – Value of physical change in inventories, withdrawals
VPCA – Value of physical change in inventories, additions
GGCE – Gross government current expenditure on goods and services
X_D – Domestic exports of goods and services
X_R – Re-exports of goods and services
M – Imports of goods and services
GR – Government revenue from sale of goods and services

Notation

V: is a matrix of the values of outputs
U: is a matrix of the values of intermediate inputs
F: is a matrix of the values of commodity inputs of final demand categories
YI: is a matrix of the values of primary inputs of industries
YF: is a matrix of the values of primary inputs of final demand categories
q: is a vector of the values of total commodity outputs
g: is a vector of the values of total industry outputs
e: is a vector of the values of total inputs (commodities plus primary) of final demand categories
n: is a vector of the values of total primary inputs (industries plus final demand categories)

GLOSSARY

Matrices

V: is a matrix of the values of commodity outputs. In it, each row shows the distribution by commodity of the output of an industry; each column shows the distribution by industry of the output of a commodity. The data relate to domestic output only. The gross output of an industry is the aggregate value of goods and services produced and work done by the industry. It is equal to the value of industry's sales plus any increase (less any decrease) in the value of physical change in stocks of finished products and work in progress.

U: is a matrix of the values of intermediate commodity inputs. In it, each row shows the distribution by industry of the input of a commodity, each column shows the distribution by commodity of the input of an industry.

F: is a matrix of the values of commodity inputs of final demand categories: personal expenditure on consumer goods and services; fixed capital formation, business and government; value of physical change in inventories, withdrawals and additions; gross government current expenditure on goods and services; exports; imports; and government revenue from the sales of goods and services.

YI: is a matrix of the values of primary inputs of industries. Primary inputs are those inputs which are not current outputs of other industries. These are indirect taxes, subsidies, wages and salaries, supplementary labour income, net income of unincorporated business and other operating surplus. (In this report, the term "other operating surplus" and "surplus" have been used interchangeably.)

YF: is a matrix of the values of the primary inputs associated with final demand categories. These consist of indirect taxes, labour income, and depreciation which is part of surplus. The labour income includes wages and salaries and supplementary labour income paid by the government and personal sectors. The estimate of surplus (depreciation) relates to the government sector and non-profit institutions in the personal sector.

Industry – An industry is defined as a group of operating units (establishments) engaged in the same or similar kind(s) of economic activity, e.g., coal mines, clothing factories, department stores, laundries. In the Input-Output Tables only domestic industries which primarily produce goods and services for sale at a price which is normally intended to cover their cost of production are included; also included are entities, such as owner-occupants of housing and subsistence farming, which produce goods and services similar to and use processes and resources similar to typical industries even though they do not produce for market. Other entities, although listed in the Standard Industrial Classification, are not included as industries in the Input-Output Tables as they do not meet the above criteria; examples are most government departments, public hospitals, schools (except private) and universities.

Commodity – A commodity is defined as a good or service normally intended for sale on the market at a price designed to cover the cost of production.

Establishment – An establishment is defined as the smallest unit that is a separate operating entity capable of reporting all elements of basic industrial statistics – the main elements of input and output. It is typically a factory, mine, store, farm, airline, hotel or similar unit and in most cases it is a separate company.

Purchasers' prices – The cost of goods and services in the market to the point of delivery to the purchaser. The purchasers' price can vary with circumstances, e.g., where the purchaser picks up the commodity at the producer's point of shipment rather than having it hauled by a common or contract carrier at the expense of the producer.

Producers' prices – The selling price at the boundary of the producing establishment excluding sales and excise taxes levied after the final stage of processing; equals purchasers' prices less transport, trade and commodity indirect tax margins where applicable.

and selected definitions and an extensive section on the mathematical treatment of analytic uses were given. This document gives the most complete description of the development of the accounting framework and the classification systems that underlie the current Canadian tables, although subsequent work has led to refinements in the classification systems, particularly in the articulation of the categories of final demand, in comparison to the preliminary 1961 tables. Further evidence of the contemporary Canadian work on the development of rectangular input-output tables, applied in a provincial context, can be found in Rapport intérimaire sur le système de comptabilité économique du Québec, le système et son fonctionnement, Bureau de la statistique du Québec et Laboratoire d'économétrie, Université Laval: juillet 1967. Another illustration of the application of the Canadian input-output accounting framework in a provincial context can be found in Input-Output Study of the Atlantic Provinces, 1965, by Kari Levitt; Vol. I, Social Accounting Matrix and Models (catalogue 15-503E). Vol. II, Structural Analysis and Data Sources (catalogue 15-504E), published by Statistics Canada.

Current Price Input-Output Tables: Three data tables are prepared and presented for each year: (1) Make Matrix, (2) Use Matrix, and (3) Final Demand Matrix. At the most detailed level, the system is balanced with 191 industries, 595 commodities and 136 categories of final demand. In addition there are seven primary inputs: wages and salaries, supplementary labour income, net income of unincorporated business, other operating surplus, commodity indirect taxes, other indirect taxes, and subsidies. At this level of detail, some of the entries in the various matrices are confidential under the provisions of the Statistics Act. Though all the tables are prepared at the L level of aggregation, it is only at aggregation level S and M that we publish these tables. The dimensions of these aggregations are given below:

Designation of aggregation	Number of industries	Number of final demand categories	Number of commodities and primary inputs
S	16	14	49
M	43	29	100
L	191	136	602

The three data tables are published both at aggregation S and M. As well, two impact (Inverse) tables - one at each aggregation S and M - and a table on commodity margins at aggregation M are published annually. Thus, in total, nine tables are published for each year. In addition to these public tables, we provide at request,

additional detail or special aggregation, subject to confidentiality, of the Input-Output data at the L level of aggregation.

As noted, the Make Matrix (matrix of the values of commodity outputs), Use Matrix (matrix of the values of intermediate commodity inputs as well as primary inputs) and Final Demand Matrix are presented for each year. In addition to these tables, our annual publication, The Input-Output Structure of the Canadian Economy (catalogue 15-201) has the following textual detail distributed in four chapters and three appendices. Chapter 1 gives the detailed conceptual framework of the Canadian Input-Output Tables, and contains a description of these matrices and their interconnections; it also outlines the relationship of these Accounts to the other parts of the System of National Accounts. Chapter 2 describes the sector, industry, commodity and final demand classification systems. Appendix C on Aggregation Parameters for the Input-Output Tables gives a listing of the industry and commodity and final demand detail at the L aggregation level and indicates the derivation of various aggregations. This appendix is thus complementary to Chapter 2. Chapter 3 discusses the special definitions used in the Input-Output Tables, noting the treatment adopted and the cases where such definitions differ from the ones used in the other subsystems of the Canadian System of National Accounts. Chapter 4 deals with the Input-Output Model and explains its specifications in terms of the accounting framework used in the Canadian Input-Output Tables. Appendix A presents a brief description of Sources and Methods used in the Canadian Input-Output Tables. Appendix B is primarily designed to serve as an introduction to Input-Output Tables for those users of statistics who are less familiar with this presentation of data.

Constant Price Input-Output Tables: As in current prices, the balancing of the constant price tables and the complete deflation process are carried out for each year for 191 industries, 595 commodities and three primary inputs (commodity indirect taxes, other indirect taxes, and subsidies) and 136 categories of final demand. Gross Domestic Product at factor cost is calculated residually through the use of double deflation.

Three data tables are prepared and presented for each year: (1) Make Matrix (2) Use Matrix (the matrix of the values of intermediate commodity inputs as well as primary inputs) and (3) Final Demand Matrix. Though all of the tables are prepared at the L level of aggregation, it is only at the aggregation levels S and M that tables are published. The dimensions of these aggregations are identical to the ones in the current price tables except that the factor inputs are combined into Gross Domestic Product at factor cost. Impact tables are not presented in constant prices though we would do so at request.

In addition to these six tables for each year, textual material spread over three chapters as follows is presented in our annual publication, The Input-Output Structure of the Canadian Economy in Constant Prices (catalogue 15-202). Chapter 1 gives the conceptual framework of the Canadian Input-Output Tables and contains a description of the matrices and their inter-connections. Chapter 2 describes the deflation process while Chapter 3 guides the reader through the tabular presentation of the Input-Output matrices.

Commodity Balancing

The fundamental element in statistical compilation is classification. Input-Output Tables classify transactions both by industry and by commodity. The industrial classification of transactors (the Standard Industrial Classification) has been in place for some time and presents no major problems. However, an accounting of economic activity requires a measure of what is done as well as who does it. A commodity balance is such a complete accounting, and as commodity balances are compiled only in the context of Input-Output Tables, it is not surprising that serious problems are encountered in imposing this additional demand on the existing data base.

There are three logically separable phases to constructing commodity balances. The obvious first requirement is a system of classification for commodities (goods and services) that can be consistently applied to all branches of economic activity. This requires that a commodity be coded consistently whether produced by a manufacturing industry, imported or exported, transported by boat, train or aeroplane, or purchased by some industry or in some final demand category. The classification system actually encountered in each of these spheres of activity tends to be peculiar to it, reflecting special interests and historical development. It is not surprising to find that export commodity classes reflect the importance of goods exported, and the same is true of import commodity classes, etc. But commodity balances require consistent commodity classes applied to all transactions, and in sufficient detail to be analytically meaningful. Thus the development and continued application of a consistent commodity classification system is a major undertaking by the Input-Output analyst.

The second requirement is to fill major holes in the basic data bases. In spite of the vast array of statistics collected, there are significant and important areas affording very little direct knowledge, and, even that, often at very infrequent intervals. The data base for manufacturing is more highly developed than for most

other industries; yet the annual census provides no data on purchased services, and the commodity composition of inventories is unknown. Some industries are surveyed only at decennial census intervals, and then little detail on operating structures is obtained. In such cases, the required series are estimated using related indicators, ad hoc studies and occasional surveys, etc. For example, taxation statistics for corporate and unincorporated businesses provide evidence on the gross output of some industries, implicit input structures in other cases, even though the classification of multi-establishment companies is not consistent with the establishment-based concept of the Input-Output Tables. The point to be noted here is that various sources, some having direct reference but others providing only inferences and indicators, must be used in compiling the Input-Output Tables.

The diverse classification systems peculiar to the different spheres of economic activity are confronted and molded into a common system of adequate consistency and the resulting data are then analysed. Varied and unpredictable differences immediately become apparent. This brings us to the final phase in commodity balancing. Supply must equal disposition for each of the 595 commodities. The under-or-over allocation of commodities must be examined and eliminated. The discrepancy may be due to several reasons - production may be unreported or misclassified; imports and exports may be improperly valued, as well as misclassified; timing inconsistencies, etc. There are no ready-made statistical approaches to solving such imbalances. The only approach is laborious investigation; one has to go back to the basic records to locate the sources of such imbalances. It is our experience that the commodity balance approach with its detailed accounting of output by industries and of use by industries and final demand transactors, uncovers major problems in both statistics reported and classification.

Valuation

The Input-Output Tables are initially constructed in current prices with the entries valued at purchasers' prices, with subsequent calculation of the tables at producers' prices. Purchasers' prices represent what the purchaser pays while producers' prices are what the producer receives, the difference is the trade, tax and transportation margins. In producers' prices a commodity has the same valuation base throughout the system.

Note that what we call "Producers' Prices" are, in the UN SNA terminology "approximate basic values". Our valuation in producer prices is readily understood by the industry experts and the data are easily comparable with other published series on industry statistics. We believe that it is quite important to keep our concepts

as close as possible with those used by industry analysts and other users who are not familiar with the nuances of SNA terminology.

Our published data tables are always in Producers' Prices. The Impact tables are manipulated from the producer price files and so are the constant price Input-Output tables. But purchaser price tables are available to any user on request.

Margins

There are seven margins distinguished in the Input-Output Tables: retail margins, wholesale margins, tax margins, transport margins, gas margins, storage margins and pipeline margins. In the majority of cases, particularly trade and transport margins, data on the appropriate margin to be attached to each commodity are not directly available and must be estimated based on partial evidence and professional judgement.

Trade Margins: Data on margins by commodities are generally not available. For wholesale and retail trade margins, gross trading margins by type of store are first calculated. Occasional commodity surveys provide a basis for allocating the type of store margins to groups of commodities. These estimates by type of store and by commodity group are fit into a statistical framework and balanced. To complete the first stage the margin by commodity groups are expanded into the full detailed input-output commodity classes using proportionality assumptions. This exercise provides the first approximation of the margins on each commodity. In the next stage, i.e. at commodity balancing, margins may be modified in the light of the commodity balances and price spread studies. The industrial distribution of these margins is based on the Census data on class of customer and other relevant information and estimates.

Transport Margins: Transport margins are developed by mode of transportation (such as air, rail, water, services incidental to water, truck and other services incidental to transportation) giving the cost of transportation by commodity going from producer to purchaser. Most of the transport margins are generated by railways and trucks. Railways can distinguish freight revenue by about 300 commodity groups. This statistical and commodity coverage is not quite complete but useful to get first approximation of the values of rail transport margins. The annual Truck Commodity Origin and Destination Survey gives revenue and tonnage by approximately 450 commodity groups. Certain ad hoc studies and surveys with a big dose of professional judgement whetted by industry experts, complete our first estimates for transport margins.

Gas margins are straightforward as all the gas margins apply to commodity, Natural Gas. Pipeline distribution margins are directly allocatable to natural gas and crude oil. Storage margins apply to a very few primary outputs such as Wheat and barley; most of the storage charges are not on commodity margins but charges for storing household effects.

Tax Margins: Examples of tax margins are federal excise taxes, import duties, gasoline taxes, liquor gallonage taxes, profits of provincial government - run liquor commissions. Provincial sales taxes are allocated direct to categories of final demand as well as such intermediate industries as construction. All other tax margins are distributed by commodity. It is a painstaking exercise to go through the myriad tax levies and tax exemptions. This tax margin allocation is further subjected to an informal consultation with tax experts and other knowledgeable persons.

Use of imports versus domestic production

The value of inputs into the Use Matrix as well as the Final Demand Matrix includes (where applicable) imports as well as commodities produced by the domestic economy. The basic economic records such as Census of Manufactures make no distinction between imports and domestic production for raw materials purchased for further processing. Similarly the Final Demand transactors such as the Household sector, Government sector, Business sector (for capital formation) do not record the purchase of commodities in terms of their origin-imports versus domestic production.

We notice that some countries produce Intermediate Transactions Matrix broken down into Domestic Production versus Imports. They must have formidable basic records to produce such tables. Or, may be, they are far more imaginative than we are. Recently OECD asked us to fill a standardized questionnaire wherein the origin of inputs between imports versus domestic production is maintained. We could not fill this part of the questionnaire.

In our tables, we show Imports as a negative column in the Final Demand Matrix. One could though assume that imports are a fixed share of total supply for each of the individual users, hence prorate imports over all users. This way one could produce a matrix of Inputs for imports and domestic production separately. But this is not a statistical table, only a display of assumptions.

There are certain very limited number of commodities which are not produced at all in Canada; these will include tropical fruits, coffee, tea, rubber etc. Use of these commodities is shown in the Canadian I-O tables as rows just like use of other commodities.

We have assumed that the valuation of imports which is equivalent to the "producer price" of domestic production is imports c.i.f. to the border plus import duties.

Transfer of secondary outputs

The Canadian I-O tables are not inter-industry but have commodity industry dimensions. The number of commodities is larger than the number of industries. We do not purify industries by transferring their secondary or subsidiary output except for own account construction (see below for construction). Industries by definition will produce their own principal products, but if there is a subsidiary output, it is left in the industry. We think that this reflects better the transactions and then we can easily relate our data with other statistics published in an industry framework. It is here that the role of Input-Output tables as a statistical audit for other economic statistics becomes relevant and important.

Aggregation

As noted above, the Canadian Input-Output tables are completely balanced at the L level of aggregation but are published at aggregation level S and aggregation level M. The levels of aggregation are hierarchical. Level S can be derived from the level M and the level M can be derived from the level L. The hierarchical basis of aggregation is true for industries, commodities and categories of final demand.

Gross output of industries and gross intermediate inputs of industries do not change with any aggregation. We do not eliminate inter-industry inputs at any level of aggregation.

But one must realize that the same data base could give different results depending upon the level of aggregation the model builder has used. Aggregation is quite a serious problem but unfortunately one does not hear much of it in most economics text books. Aggregation forces a particular point of view, a particular analysis. Indeed, aggregation itself is a model.

Let me elaborate the above point using the Canadian input-output tables. Input-output impact tables are published at two levels of aggregation for all the seventeen years 1961-77. Still another level of detail (which we do not publish so as to avoid disclosure of information on individual firms) is used internally for model building. We looked at a particular commodity and a particular industry whose definitions remained the same at the two published aggregations. The impact of this particular

commodity on the particular industry was different depending upon which (level of aggregation) impact tables one looked at. This is a seemingly anomalous situation. However, this apparent anomaly can be explained by the fact that other commodities (other than the one under study) were aggregated differently in the two aggregations. But the fact remains that different aggregations give different results.

One might draw a lesson. One must avoid the temptation, as much as possible, to aggregate data in the early stages of economic analysis. Aggregation is easier to do than disaggregation. The implications of this simple statement must be well understood. We strongly recommend to pay attention to keeping micro data sets. I say "keeping" micro data sets because data sets from the respondents are made available in this form. With them one would be able to arrange custom - made aggregations for economic analysis. It goes without saying that the data retrieval system should be efficient. Without an efficient data retrieval system, one will remain a prisoner of dictated (by others) aggregations and ones' horizon of economic analysis will remain narrow indeed.

Construction

Construction is defined in the Canadian I-O tables as work put in place both by establishments classified to the construction industry as well as by the own account construction activities by other industries. Thus the total activity of construction is brought together in the I-O tables and transfers are accordingly made from the various industries to the Construction activity vectors of the I-O tables. We have broad 'information' on the labour component and the material component of construction activity broken by own account and contract but we have no regular surveys giving us input detail by commodity. It is somewhat easier to imagine a particular commodity going into a typical construction structure but it will be most difficult to estimate its allocation by own account versus contract. The sheer lack of input detail forced us into putting the entire construction activity together. As well, there are some details available from ad hoc studies giving input detail of structures. These two considerations forced us to put the entire activity together.

Government Sector

The Government sector accounts usually follow a functional classification, with only minor consideration for an economic object classification. The first major problem is to convert the functional detail into an economic object classification. The second problem is that governments are not asked to fill a structured questionnaire as are the industrial respondents. Governments keep their records in a way

which is satisfactory for legislation needs, but not necessarily for statistical needs. Records of the various levels of government, federal, provincial and municipal are unstructured and then the commodity detail is lacking. The available data are for very broad categories. The Input-Output analyst must estimate the detail by reference to detail buried behind the published records, and diligently code myriad information spread over tabular and textual forms. The commodity detail information is rather weak in the basic public accounts of the Government sector.

Capital Formation

Statistics Canada collects information by industry on total capital formation on construction and on Machinery and Equipment. Hardly any information is collected on the type of commodity that an industry purchases on capital accounts. One has to study each commodity which could possibly be capitalized and then decide its allocation to a particular industry. Surprisingly a large number of commodities can quite easily be allocated. Some types of machinery are industry specific hence easily codable to a given industry. Once one has exhausted the commodity supply side, then one checks the allocation totals to see if they are different from the survey ones. Going back and forth a couple of times will in most cases fix rather well the allocation by detail and total.

The Input-Output Accounts and Their Relationship to the System of National Accounts

Input-Output Tables form part of the broader Canadian System of National Accounts which includes (in addition to Input-Output Tables) the Income and Expenditure Accounts, the Indexes of Real Domestic Product by Industry, Productivity Studies, the Financial Flow Accounts, the Balance of International Payments and balance sheets showing the assets and liabilities of the economy. The System of National Accounts was originally developed to satisfy the need for consistent and comprehensive measures of economic activity. As demands for data for economic analysis have grown over the years, the conceptual framework has been extended and refined; at the same time flows of data have been established to fill in the System through the exploitation of existing sources of information, the development of new sources, and the design of new estimating techniques.

The best known Accounts of the System are the Income and Expenditure Accounts which were designed, in the main, to provide current and comprehensive, though relatively aggregative measures of the output of the economy in two ways: (1) as the value of the "final" expenditure on goods and services by the various sectors of the economy, less total imports of goods and services, and (2) as the income accruing to

(or costs of) primary factors of production engaged in the production process plus certain non-factor costs such as indirect taxes.

The items of final expenditure are identical in both the Income and Expenditure and the Input-Output subsystems. On the Gross Domestic Product side, the Input-Output breakdown of primary inputs is less detailed. The term operating surplus in the Input-Output Accounts encompasses Profits and other investment income, capital consumption allowances, inventory valuation adjustments etc.

The Input-Output Tables, and the estimates of Gross Domestic Product derived from them, use somewhat different statistical sources than the Income and Expenditure Accounts. Notwithstanding the different approaches used, the estimates of Gross Domestic Product for the economy as derived from the Input-Output Accounts very closely approximate those in the Income and Expenditure Accounts.

The notable difference in the two subsystems is in the estimation of operating surplus. In the Input-Output Accounts, the data are derived from establishment-based surveys, such as annual Census of Manufactures, and surplus is essentially calculated in the context of a balance between inputs and outputs. In the estimate of the components of surplus for Income and Expenditure Accounts, the data sources are surveys of companies and other administrative records. The use of the different statistical reporting unit yields differences in industrial allocations.

On the Expenditure side, there are some minor differences in the estimates of current government expenditure, exports and imports, inventories and personal expenditure. The differences in the estimates of current government expenditure and exports and imports are definitional. One example of a definitional difference is the treatment of research grants for defence which are treated as transfer payments in the Input-Output Accounts but as purchases of government services in the Income and Expenditure Accounts. In imports and exports, the transfers of funds by trade unions are treated as transfers in Input-Output Accounts and as sales/purchases of goods and/ services in Income and Expenditure Accounts.

The valuation of physical change of inventories presents difficulty in both the Input-Output and the Income and Expenditure Accounts. There is a lack of data on the valuation practices as well as on the commodity content of inventories. The two subsystems use different techniques for measuring value of physical change of inventories (VPC). For example, in the Income and Expenditure subsystem, the value of change of inventories in 1977 is equal to closing inventories in 1977 less closing inventories in 1976. In the Input-Output subsystem, VPC of inventories equals closing

inventories in 1977 less opening inventories in 1977. The closing inventories of 1976 differ from the opening inventories of 1977 because of : classification changes; changes in the basis of valuation; and births and deaths of establishments.

Consumer expenditure makes up about three fifths of the Gross Domestic Product at market prices, yet this is one sector not supported direct with regular surveys. In the process of commodity balancing, it is necessary to have estimates of the categories of consumer expenditure and their commodity content. Thus considerable care, using a range of data sources, is taken in estimating the various categories of personal expenditure and the commodity composition of each category.

Occasional Family Expenditure Surveys provide information on the pattern of consumer expenditure. In addition, the Retail trade surveys when used with information on class of customer and commodity content of sales by type of store provide estimates of consumer expenditure. Balanced tables for preceding years do provide a reference point, and retail sales by type of store can be short run indicators of the consumption of related groups of commodities, although experience suggests that this approach be used with caution. In many cases, estimates can be verified against trend in real consumption per person. Additional information on consumer expenditure is available in the form of data on direct selling by Manufacturers, a detailed breakout of the disposition of energy from the Quarterly Report on Energy Supply Demand in Canada, data from Trade Associations, and of course from the operating statements of some of the private non-profit organizations which form part of the Personal sector. The outputs of certain commodities like imputed and paid rent, domestic services are allocated direct to consumers.

The Income and Expenditure Accounts show a separate entry called "Residual error of estimate", as a measure of the statistical discrepancy between the "income side" and the "expenditure side" of the accounts. In the Input-Output Tables, where each Industry and each Commodity Account must balance, there is no "residual error of estimate". The supply side is always equal to the disposition side for any commodity and all commodities. Deducting from the total supply (or disposition) a common intermediate expenditure total gives GDP or Expenditure on GDP. Thus GDP cannot be different from Expenditure on GDP.

Constant Price Input-Output Tables

With the decision to establish a program of annual input-output tables in current prices, tables at constant prices were a logical corollary. In Canada one of the roles of input-output tables is to serve a supportive and integrating role for

other parts of the system of national accounts and input-output tables at constant prices are necessary to completely fulfill this function. While, on the face of it, the construction of input-output tables in constant prices simply involves restating the commodity values from the current price tables in base year values, in fact a number of problems were encountered, and this section describes some of these problems, how they were approached and how they were resolved. It is important to note that there are a number of problems to which we do not yet have definitive solutions and these areas are continuing to be explored and developed as resources permit.

At the time the project was initially started the literature available to guide us was relatively sparse. More recent references, particularly the United Nations Manual on National Accounts at Constant Prices[2] have reinforced most elements of the approach we adopted.

Before discussing some of the problems and some of the features of the Canadian I-O tables a brief general description of the approach to deflation is necessary. The Canadian I-O tables in current prices are published at producers' values, but are in fact compiled as noted above at both producers' values and at purchasers' values. It might be possible to carry out deflation on either valuation basis, but deflation of producers' values offers a number of advantages, and this is in fact done. The Canadian Manufacturing Industry Selling Price Indexes are measured at the factory gate before inclusion of commodity indirect taxes or outward transportation, and these price indexes serve as the basis for calculation of the deflators for a majority of the commodities.

In valuation at producers' prices all commodity transactions are on a uniform basis of valuation thus permitting the use of a single price deflator across a commodity vector. In tables at purchasers' values, each transaction is potentially a unique amalgam of producers' value and various margins, and thus presenting almost impossible demands on the construction of price deflators. In tables at any basis of valuation the problem of deflating the tax, trade and transport margins as commodities must be faced.

In the following paragraphs the development of the constant price input-output tables are examined from two points of view. The paragraphs immediately below note some of the aspects of relating the constant price input-output tables to other accounts in the Canadian System of National Accounts. Subsequent paragraphs discuss

2 ST/ESA/STAT/SER.M/64; United Nations, New York, 1979.

some of the problems peculiar to input-output tables, problems not encountered in constructing the tables at current prices. Of course all aspects of the tables are interrelated and these distinctions are made for the purpose of exposition.

The traditional measures of production published in Statistics Canada to which the input-output tables can be related are Gross National Product, Gross National Expenditure (the National Income and Expenditure Accounts) and Real Domestic Product by Industry. Only Gross National Expenditure (GNE) and Real Domestic Product by industry (RDP) are published in constant prices.

The input-output tables encompass both GDP by industry and Expenditures on GDP and thus provide the only mechanism whereby the RDP measures can be reconciled with constant price GNE. While the theoretical concept of the RDP measures is similar to constant price GDP from the Input-Output tables there are of course differences in methodology[3]. The input-output tables employ double deflation for all industries but the RDP indexes are constructed from single indicators or double deflation, taking no express account of some service inputs. Where double deflation is employed in RDP, inputs are recorded at pruchasers' values and the outputs at producers' values. Thus complete reconciliation of the RDP indexes with the input-output tables cannot be definitive but problem areas can be identified.

We have also observed that there can be significant difference between the growth in production at factor cost and at market prices - such as when imports (which are taxed, but do not form part of domestic production) account for a changed share of domestic demand, or when the commodity composition of domestic demand shifts to more (or less) highly taxed commodities.

As was noted above, the estimate of Expenditure on GDP from the input-output tables can corroborate or refine the final demand categories in the GNE accounts. In constant prices, there is another dimension to the relationship between the final

3. While the preparation of both annual constant price input-output tables and annual RDP indexes appears to have some elements of duplication, the RDP indexes do present a long historical series (from 1935 for total RDP, from 1919 for the Index of Industrial Production) of Real Output by industry measured on a consistent basis. The annual RDP indexes also serve as the basis for monthly estimates of real output by industry in the current period.

demand estimates from the input-output tables and GNE from the Income and Expenditure Accounts. Taking consumer expenditure as a particular example, final demand at constant prices from the input-output tables is calculated as the sum of commodities at producers' values, deflated with appropriate price indexes, and the various margins at constant prices.

The GNE account is estimated at purchasers' values, and deflated with purchasers' price indexes, principally elements of the Consumer Price Index (CPI). Thus the input-output tables present a powerful tool for reconciling different price indexes at different levels of valuation. Our experience with this exercise has been surprisingly good. The first add-ups revealed a few problems but analysis of these cases provided straight forward solution in most instances, leaving only a few areas, such as clothing which is recognized as notoriously difficult to price, for further development.

There are also some problems in deflation which are largely peculiar to the internal characteristics of the input-output tables. The principal ones are noted below.

It was perhaps not surprising to discover that the commodity classification system developed for the current price input-output tables did not always result in commodity classes that were sufficiently homogeneous for deflation purposes - either from the point of view of the diversity of varieties within classes or of market differentiation. In the next review of the commodity classes attention will be directed to the needs for deflation, but considerable progress has been made. In the current tables imports of a commodity are routed with the domestic production of the same commodity. To the extent that import price indexes are available corresponding to the input-output commodity classes, imports in the input-output tables are deflated with import prices. Domestic output and exports are deflated with domestic prices, and all categories of domestic use, intermediate and final, are deflated with a weighted import and domestic price index. Similarly where exports attract a different price from the domestic market, exports are deflated with a special price index. Within the domestic market some commodities exhibit price discrimination, and the flow of these commodities to each market is deflated by the price appropriate to that market. For the commodity pipeline transportation it was observed that pipelines carrying natural gas behaved differently for pricing than pipelines carrying petroleum products. This became two commodities for deflation. At present the price deflator for Transportation margins is a weighted average for all modes of Transport and for all commodities, but work is under way on developing price indexes for Transport margins classified both by commodity and by mode of Transport.

Probably the major problem in constructing constant price input-output tables is the deflation of Trade margins, although the measurement of the output (constant price margins) of Trade industries is always difficult whether within or outside the input-output framework. While a number of approaches were considered, two have been tried, with results that have been acceptable but not fully satisfactory. The suggestion of calculating margins in constant prices as the product of the margin rate in the base year and the volume of the commodity being traded was rejected on conceptual grounds. Constant margin rates imply a constant proportionality between the volume of a commodity being sold and the quantity of trade margin or service being attached to that good. Observation of the market place in action suggests this isn't so. Marketing techniques are constantly changing and the quantity of distribution service is generally becoming less. Filling stations require drivers to pump their own gasoline; free delivery becomes charged for; packaging and display are "economized" to reduce costs. The first approach adopted was to use the margin rates for each year from the current price tables. Thus the margin rates at current and at constant prices were the same, with the changing rates reflecting changes in the quantum of services. This approach worked reasonably well and is incorporated into our published tables for the years 1961-1971. It may also be noted that this was a period of relatively stable prices. This technique was originally carried into the 1970's with less agreeable results.

The use of current year trade margin rates exacerbated the effects of rapidly changing prices combined with a great diversity in mark-up practices. The next step was to emulate Goldilocks and the Three Bear's in search of some formula that seemed "just right". The closest to Baby Bear's porridge proved to be using a margin rate calculated as the average of the given year's rates and the base year's rates from the current price tables. The two principal criteria by which different approaches were evaluated were reasonable productivity measures for the trade industries and an implicit price at purchasers' values that most closely approximate observed purchasers' prices. As mentioned above, this is one of the areas we plan to continue to investigate.

Indirect taxes and subsidies present few difficulties in constructing constant price input-output tables at both factor cost and market prices. Commodity indirect taxes at base year prices are of course calculated as the product of the base year tax rate and the quntum of the commodity taxed. Some slight imprecision can arise because it is not known just what margins should be added to the producers' value to calculate the tax. For highly taxed commodities such as alcoholic beverages, where in Canada at least, the tax is a large multiple of the producers' value of the commodity, any (say) timing error in the producers' value of the commodity as recorded

gets greatly inflated in the tax calculation. In the case of subsidies, in the majority of cases for the significant subsidies it has been possible to identify the commodity being subsidized; the procedure then becomes analogeous to commodity indirect taxes. In the more trivial cases the subsidy is calculated as a fixed (base year) proportion of the constant price output of the industry receiving the subsidy.

One other problem, mentioned last because it arises less frequently is the problem of rebasing constant price input-output tables. Periodic rebasing is necessary in constructing longer time series and the general Canadian practice has been to rebase at about ten-year intervals. These time segments are linked in a backward chained Laspeyres measure, with the chaining periods being the ten year intervals. Chained indexes are unfortunately not additive, and this non-additivity gives rise to adjusting entries which are implicit when the constant price series is expressed in index number form (the indexes of RDP) or explicit when given in actual currency units (as the constant dollar GNE). The matrix presentation of the input-output tables does not lend itself to the inclusion of adjusting entries, and thus we cannot present chained rebased input-output tables in the same mode as the other constant price production accounts in the Canadian System of National Accounts. At the present time Canada has annual tables for seventeen years 1961-1977, with the whole period based on 1971 prices; in addition the tables for the years 1961-71 are available at constant 1961 prices. But the use of one base year becomes less defensible as the time period lengthens.

With this note, two sets of tables (one in current, the other in constant prices) at S aggregation are given for the year 1977. The current price set includes Make Matrix, Use Matrix, Final Demand Matrix and Inverse Matrix. The constant price set includes Make Matrix, Use Matrix and the Final Demand Matrix. As mentioned earlier in the introduction similar sets for all years 1961-77 are published at M and S levels of aggregation; in addition, Margins in current prices at M aggregation commodities are published for all years 1961-77.

Conclusions

The Input-Output Accounting framework, when set in commodity industry dimension, provides a powerful statistical audit mechanism for improving consistency, integrity and comprehensiveness of economic statistics. This aspect of the compilation of Input-Output tables has, in our mind, not been delineated properly in the literature. Compilation of Input-Output tables forces a reexamination of various and unintegrated commodity classification schemes prevalent in any central statistical organization; it brings to the forefront, as a matter of routine, any statistical holes in economic

statistics; it brings to light the various and unintegrated valuation practices in economic series; it provides a meaningful, comprehensive and integrated data base to reconcile the expenditure side of the national accounts with the income side in both current and constant prices.

The compilation of Input-Output tables serves several roles but the one which has so far dominated, at the cost of others, is the role in providing the framework for Impact analysis with given shocks in the final demand. In Canada, our program, as an illustration, serves at least the following roles:

(i) Analysis of the structure and studies of the impact (direct and indirect effects) of exogenous factors on the economy in contrast to the macro economic analysis possible from the data bases of the other sub-systems of the Canadian System of National Accounts (CSNA).

(ii) Market Analysis in the context of a detailed, comprehensive and consistent data base on the supply and demand of commodities.

(iii) Basis for new frontiers in productivity analysis.

(iv) A statistical audit of the consistency, integrity and comprehensiveness of economic statistics.

(v) Benchmarks for the production accounts in the CSNA.

(vi) Source of algorithms in the development of weighting patterns for price indexes, say, for capital formation.

When compilation is viewed in its broader role, the periodicity of Input-Output tables becomes an important question. Input-Output tables can serve better their broad role and be of high quality if they are produced annually. Time series improve quality of output and the experience of the staff remains relevant and useful.

We made a reference to aggregation problems in this paper. It is absolutely essential to develop efficient data retrieval system. Furthermore, basic Input-Output tables must be balanced at as micro level as possible and this micro data set be preserved. It is worth emphasizing that the economics profession should pay more attention to the problem of aggregation of economic series and the errors which ensue with various levels of aggregation.

TABLE 01. MAKE (OUTPUT) MATRIX (AGGREGATION - S), 1977 (MILLIONS OF DOLLARS)

NO.	COMMODITY AGGREGATION - S	AGRICULTURE	FORESTRY	FISHING, HUNTING & TRAPPING	MINES QUARRIES & OIL WELLS	MANUFACTURING	CONSTRUCTION
1	GRAINS	2727.5	--	--	--	0.2	--
2	OTHER AGRICULTURAL PRODUCTS	7485.0	28.8	--	--	19.1	--
3	FORESTRY PRODUCTS	78.4	2926.2	--	--	71.5	--
4	FISHING & TRAPPING PRODUCTS	--	--	527.3	--	--	--
5	METALLIC ORES & CONCENTRATES	--	--	--	4141.8	298.4	--
6	MINERALS FUELS	--	--	--	9208.0	62.7	--
7	NON-METALLIC MINERALS	--	--	--	1198.5	44.9	--
8	SERVICES INCIDENTAL TO MINING	--	--	--	1394.3	--	--
9	MEAT,FISH & DAIRY PRODUCTS	111.8	--	3.4	--	9073.8	--
10	FRUIT,VEG.,FEED,MISC.FOOD PROD	19.5	--	--	--	7646.1	--
11	BEVERAGES	--	--	--	--	2220.0	--
12	TOBACCO & TOBACCO PRODUCTS	--	--	--	--	902.9	--
13	RUBBER,LEATHER,PLASTIC FAB.PRO	--	--	--	--	2859.7	--
14	TEXTILE PRODUCTS	--	--	--	--	2735.7	--
15	KNITTED PRODUCTS & CLOTHING	--	--	--	--	3272.7	--
16	LUMBER,SAWMILL,OTHER WOOD PROD	--	39.9	--	--	6104.8	--
17	FURNITURE & FIXTURES	--	--	--	--	1565.3	--
18	PAPER & PAPER PRODUCTS	--	--	--	--	8999.9	--
19	PRINTING & PUBLISHING	--	--	--	--	3544.4	--
20	PRIMARY METAL PRODUCTS	--	--	--	1.5	9691.6	--
21	METAL FABRICATED PRODUCTS	--	--	--	--	7066.0	--
22	MACHINERY & EQUIPMENT	--	0.2	--	46.9	4343.7	--
23	AUTOS,TRUCKS,OTHER TRANSP. EQP	--	--	--	--	15871.2	--
24	ELEC. & COMMUNICATIONS PROD.	--	--	--	--	5498.6	--
25	NON-METALLIC MINERAL PRODUCTS	--	--	--	12.9	3090.7	--
26	PETROLEUM & COAL PRODUCTS	--	--	--	476.4	8826.5	--
27	CHEMICALS,CHEMICAL PROD	--	--	--	368.0	6606.3	--
28	MISC. MANUFACTURED PRODUCTS	--	--	--	--	2166.6	--
29	RESIDENTIAL CONSTRUCTION	--	--	--	--	--	10822.6
30	NON-RESIDENTIAL CONSTRUCTION	--	--	--	--	--	19065.3
31	REPAIR CONSTRUCTION	--	--	--	--	--	6228.2
32	TRANSPORTATION & STORAGE	--	3.8	--	--	16.8	--
33	COMMUNICATION SERVICES	--	--	--	--	--	--
34	OTHER UTILITIES	--	--	--	2.4	47.7	--
35	WHOLESALE MARGINS	--	5.7	--	1.7	2560.0	--
36	RETAIL MARGINS	--	--	--	--	--	--
37	IMPUTED RENT OWNER OCPD. DWEL.	--	--	--	--	--	--
38	OTHER FINANCE,INS.,REAL ESTATE	8.0	1.2	--	150.0	119.2	153.9
39	BUSINESS SERVICES	--	--	--	0.6	100.2	0.1
40	PERSONAL & OTHER MISC. SERVICE	--	56.7	5.0	40.5	429.7	143.2
41	TRANSPORTATION MARGINS	--	--	--	--	--	--
42	OPERATING,OFFICE,LAB & FOOD	--	--	--	--	--	--
43	TRAVEL, ADVERTISING, PROMOTION	--	--	--	--	--	--
	TOTAL	10430.1	3062.5	535.7	17043.4	115847.2	36413.2

NOTE: DETAIL MAY NOT ADD DUE TO ROUNDING.

TABLE 01. MAKE (OUTPUT) MATRIX (AGGREGATION - S), 1977 (MILLIONS OF DOLLARS) - CONTINUED

NO.	COMMODITY AGGREGATION - S	TRANS. & STORAGE	COMMUNICATION	ELEC POWER GAS,OTHER UTILITIES	WHOLESALE TRADE	RETAIL TRADE	FINANCE, INS. & REAL EST.
1	GRAINS	--	--	--	--	--	--
2	OTHER AGRICULTURAL PRODUCTS	--	--	--	--	5.8	--
3	FORESTRY PRODUCTS	--	--	2.7	--	--	--
4	FISHING & TRAPPING PRODUCTS	--	--	--	--	--	--
5	METALLIC ORES & CONCENTRATES	--	--	--	--	--	--
6	MINERALS FUELS	--	--	--	--	--	--
7	NON-METALLIC MINERALS	--	--	--	--	--	--
8	SERVICES INCIDENTAL TO MINING	--	--	--	--	--	--
9	MEAT,FISH & DAIRY PRODUCTS	--	--	--	0.4	358.8	--
10	FRUIT,VEG.,FEED,MISC.FOOD PROD	--	--	--	26.5	38.3	--
11	BEVERAGES	--	--	--	--	--	--
12	TOBACCO & TOBACCO PRODUCTS	--	--	--	1.2	--	--
13	RUBBER,LEATHER,PLASTIC FAB.PRO	--	--	--	10.1	--	--
14	TEXTILE PRODUCTS	--	--	--	16.3	3.5	--
15	KNITTED PRODUCTS & CLOTHING	--	--	--	0.9	0.6	--
16	LUMBER,SAWMILL,OTHER WOOD PROD	--	--	--	2.6	--	--
17	FURNITURE & FIXTURES	--	--	--	7.6	--	--
18	PAPER & PAPER PRODUCTS	--	--	--	3.8	--	--
19	PRINTING & PUBLISHING	--	--	--	4.4	--	--
20	PRIMARY METAL PRODUCTS	--	--	--	--	--	--
21	METAL FABRICATED PRODUCTS	--	--	--	16.3	--	--
22	MACHINERY & EQUIPMENT	--	--	--	--	--	--
23	AUTOS,TRUCKS,OTHER TRANSP. EQP	204.9	--	--	6.6	--	--
24	ELEC. & COMMUNICATIONS PROD.	--	297.7	--	6.1	--	--
25	NON-METALLIC MINERAL PRODUCTS	--	--	--	2.0	--	--
26	PETROLEUM & COAL PRODUCTS	4.3	--	0.5	--	--	--
27	CHEMICALS,CHEMICAL PROD	--	--	--	0.5	--	--
28	MISC. MANUFACTURED PRODUCTS	--	--	--	65.9	--	--
29	RESIDENTIAL CONSTRUCTION	--	--	--	--	--	--
30	NON-RESIDENTIAL CONSTRUCTION	--	--	--	--	--	--
31	REPAIR CONSTRUCTION	--	--	--	--	--	--
32	TRANSPORTATION & STORAGE	15725.7	--	34.8	--	12.4	0.4
33	COMMUNICATION SERVICES	--	5949.8	--	--	--	--
34	OTHER UTILITIES	--	--	6219.9	--	--	--
35	WHOLESALE MARGINS	18.8	--	--	11132.8	--	--
36	RETAIL MARGINS	22.2	--	60.8	--	14076.7	--
37	IMPUTED RENT OWNER OCPD. DWEL.	--	--	--	--	--	11449.5
38	OTHER FINANCE,INS.,REAL ESTATE	52.9	4.7	11.3	49.3	62.8	25846.6
39	BUSINESS SERVICES	28.5	57.0	2.3	32.2	1.5	37.9
40	PERSONAL & OTHER MISC. SERVICE	180.4	31.5	88.8	1067.8	3040.6	697.7
41	TRANSPORTATION MARGINS	--	--	--	--	--	--
42	OPERATING,OFFICE,LAB & FOOD	--	--	--	--	--	--
43	TRAVEL, ADVERTISING, PROMOTION	--	--	--	--	--	--
	TOTAL	16237.9	6340.6	6421.1	12453.3	17601.0	38032.1

NOTE: DETAIL MAY NOT ADD DUE TO ROUNDING.

TABLE 01. MAKE (OUTPUT) MATRIX (AGGREGATION - S), 1977 (MILLIONS OF DOLLARS) - CONCLUDED

NO.	COMMODITY AGGREGATION - S	BUSINESS & PERSONAL SERVICES	TRANS. MARGINS	OPERATING OFFICE SUPPLIES	TRAVEL, PROMOTION, ADVTG.	TOTAL INDUSTRIES
1	GRAINS	--	--	--	--	2727.7
2	OTHER AGRICULTURAL PRODUCTS	--	--	--	--	7538.7
3	FORESTRY PRODUCTS	--	--	--	--	3078.8
4	FISHING & TRAPPING PRODUCTS	--	--	--	--	527.3
5	METALLIC ORES & CONCENTRATES	--	--	--	--	4440.2
6	MINERALS FUELS	--	--	--	--	9270.7
7	NON-METALLIC MINERALS	--	--	--	--	1243.4
8	SERVICES INCIDENTAL TO MINING	--	--	--	--	1394.3
9	MEAT,FISH & DAIRY PRODUCTS	--	--	--	--	9548.1
10	FRUIT,VEG.,FEED,MISC.FOOD PROD	--	--	--	--	7730.4
11	BEVERAGES	--	--	--	--	2220.0
12	TOBACCO & TOBACCO PRODUCTS	--	--	--	--	904.1
13	RUBBER,LEATHER,PLASTIC FAB.PRO	--	--	--	--	2869.8
14	TEXTILE PRODUCTS	--	--	--	--	2755.6
15	KNITTED PRODUCTS & CLOTHING	--	--	--	--	3274.1
16	LUMBER,SAWMILL,OTHER WOOD PROD	--	--	--	--	6147.3
17	FURNITURE & FIXTURES	--	--	--	--	1572.9
18	PAPER & PAPER PRODUCTS	--	--	--	--	9003.7
19	PRINTING & PUBLISHING	--	--	--	--	3548.8
20	PRIMARY METAL PRODUCTS	--	--	--	--	9693.1
21	METAL FABRICATED PRODUCTS	--	--	--	--	7072.3
22	MACHINERY & EQUIPMENT	--	--	--	--	4390.8
23	AUTOS,TRUCKS,OTHER TRANSP. EQP	--	--	--	--	16082.8
24	ELEC. & COMMUNICATIONS PROD.	--	--	--	--	5802.4
25	NON-METALLIC MINERAL PRODUCTS	--	--	--	--	3105.6
26	PETROLEUM & COAL PRODUCTS	--	--	--	--	9307.8
27	CHEMICALS,CHEMICAL PROD.	--	--	--	--	6974.9
28	MISC. MANUFACTURED PRODUCTS	7.5	--	--	--	2240.0
29	RESIDENTIAL CONSTRUCTION	--	--	--	--	10822.6
30	NON-RESIDENTIAL CONSTRUCTION	--	--	--	--	19065.3
31	REPAIR CONSTRUCTION	--	--	--	--	6228.2
32	TRANSPORTATION & STORAGE	--	--	--	--	15793.9
33	COMMUNICATION SERVICES	--	--	--	--	5949.8
34	OTHER UTILITIES	14.0	--	--	--	6283.9
35	WHOLESALE MARGINS	143.8	--	--	--	13862.8
36	RETAIL MARGINS	106.7	--	--	--	14266.5
37	IMPUTED RENT OWNER OCPD. DWEL.	--	--	--	--	11449.5
38	OTHER FINANCE,INS.,REAL ESTATE	140.4	--	--	--	26600.2
39	BUSINESS SERVICES	6548.5	--	--	--	6808.6
40	PERSONAL & OTHER MISC. SERVICE	18764.2	--	--	--	24546.2
41	TRANSPORTATION MARGINS	--	6482.5	--	--	6482.5
42	OPERATING,OFFICE,LAB & FOOD	--	--	12016.6	--	12016.6
43	TRAVEL, ADVERTISING, PROMOTION	--	--	--	6651.0	6651.0
	TOTAL	**25725.0**	**6482.5**	**12016.6**	**6651.0**	**331293.2**

NOTE: DETAIL MAY NOT ADD DUE TO ROUNDING.

TABLE 02. USE (INPUT) MATRIX (AGGREGATION - S), 1977 (MILLIONS OF DOLLARS)

NO.	COMMODITY AGGREGATION - S	AGRICUL-TURE	FORES-TRY	FISHING, HUNTING & TRAPPING	MINES QUARRIES & OIL WELLS	MANUFAC-TURING	CONSTRUC-TION
1	GRAINS	62.4	--	--	--	751.0	--
2	OTHER AGRICULTURAL PRODUCTS	450.1	--	--	--	5102.9	18.1
3	FORESTRY PRODUCTS	0.7	335.7	--	--	2730.3	10.6
4	FISHING & TRAPPING PRODUCTS	--	--	5.8	--	502.9	--
5	METALLIC ORES & CONCENTRATES	--	--	--	13.7	2551.2	--
6	MINERALS FUELS	10.2	0.1	0.2	42.4	8668.3	7.5
7	NON-METALLIC MINERALS	9.2	--	1.0	42.9	426.5	142.7
8	SERVICES INCIDENTAL TO MINING	--	--	--	501.7	--	893.2
9	MEAT,FISH & DAIRY PRODUCTS	5.8	--	--	--	1784.6	--
10	FRUIT,VEG.,FEED,MISC.FOOD PROD	1119.9	--	--	--	1816.5	--
11	BEVERAGES	--	--	--	--	132.3	--
12	TOBACCO & TOBACCO PRODUCTS	--	--	--	--	202.8	--
13	RUBBER,LEATHER,PLASTIC FAB.PRO	18.7	--	--	5.8	1278.7	446.6
14	TEXTILE PRODUCTS	26.7	6.3	11.0	2.2	2459.3	160.7
15	KNITTED PRODUCTS & CLOTHING	--	--	--	--	264.8	--
16	LUMBER,SAWMILL,OTHER WOOD PROD	4.5	--	5.1	3.4	1559.8	2103.1
17	FURNITURE & FIXTURES	--	--	--	--	76.5	25.3
18	PAPER & PAPER PRODUCTS	4.9	--	--	13.0	3245.0	261.1
19	PRINTING & PUBLISHING	--	--	--	0.5	349.7	--
20	PRIMARY METAL PRODUCTS	--	--	--	147.1	6330.4	913.4
21	METAL FABRICATED PRODUCTS	42.5	24.4	2.1	18.8	3073.2	3205.9
22	MACHINERY & EQUIPMENT	87.0	18.7	6.3	134.8	1215.7	303.8
23	AUTOS,TRUCKS,OTHER TRANSP. EQP	1.9	4.9	34.4	13.9	6905.3	65.7
24	ELEC. & COMMUNICATIONS PROD.	--	--	13.9	14.1	1483.1	1252.5
25	NON-METALLIC MINERAL PRODUCTS	5.3	0.2	0.7	35.4	1058.6	2113.6
26	PETROLEUM & COAL PRODUCTS	459.1	90.0	37.6	248.9	1538.1	507.4
27	CHEMICALS,CHEMICAL PROD.	650.6	4.7	0.9	199.6	4198.1	311.9
28	MISC. MANUFACTURED PRODUCTS	--	--	5.9	--	727.9	189.0
29	RESIDENTIAL CONSTRUCTION	--	--	--	--	--	--
30	NON-RESIDENTIAL CONSTRUCTION	--	--	--	--	--	--
31	REPAIR CONSTRUCTION	231.4	45.2	6.8	401.6	505.0	18.2
32	TRANSPORTATION & STORAGE	33.7	317.7	2.5	131.6	749.4	295.2
33	COMMUNICATION SERVICES	56.4	4.9	0.6	32.4	522.7	75.4
34	OTHER UTILITIES	161.6	1.9	0.4	271.0	1393.8	21.8
35	WHOLESALE MARGINS	309.0	22.0	13.5	131.1	2106.3	1563.8
36	RETAIL MARGINS	44.4	1.6	1.6	6.2	19.5	212.8
37	IMPUTED RENT OWNER OCPD. DWEL.	--	--	--	--	--	--
38	OTHER FINANCE,INS.,REAL ESTATE	381.8	177.4	5.9	3201.1	1484.0	543.2
39	BUSINESS SERVICES	27.6	9.5	0.8	361.3	1277.0	1250.4
40	PERSONAL & OTHER MISC. SERVICE	23.5	88.3	6.6	82.3	481.2	555.5
41	TRANSPORTATION MARGINS	114.6	7.0	4.4	56.5	2003.7	506.7
42	OPERATING,OFFICE,LAB & FOOD	255.7	402.1	7.6	1155.8	3490.3	545.7
43	TRAVEL, ADVERTISING, PROMOTION	0.5	6.8	--	85.3	2298.3	163.4
44	NON-COMPETING IMPORTS	--	--	--	--	730.0	--
45	UNALLOCATED IMPORTS & EXPORTS	--	--	--	--	--	--
46	NET INDIRECT TAXES	-40.2	53.4	-14.7	410.6	-167.4	1632.1
47	LABOUR INCOME	711.5	1118.3	125.5	2666.2	27001.1	11661.6
48	NET INCOME UNINC. BUSINESS	2841.0	46.0	168.5	21.9	134.0	1281.0
49	OTHER OPERATING SURPLUS	2318.1	275.3	80.7	6590.6	11384.9	3154.1
	TOTAL	**10430.1**	**3062.5**	**535.7**	**17043.4**	**115847.2**	**36413.2**

NOTE: DETAIL MAY NOT ADD DUE TO ROUNDING.

TABLE 02. USE (INPUT) MATRIX (AGGREGATION - S), 1977 (MILLIONS OF DOLLARS) - CONTINUED

NO.	COMMODITY AGGREGATION - S	TRANS. & STORAGE	COMMUNI-CATION	ELEC POWER GAS,OTHER UTILITIES	WHOLESALE TRADE	RETAIL TRADE	FINANCE, INS. & REAL EST.
1	GRAINS	--	--	--	10.8	--	--
2	OTHER AGRICULTURAL PRODUCTS	4.6	--	--	1.4	349.6	--
3	FORESTRY PRODUCTS	--	--	--	--	--	--
4	FISHING & TRAPPING PRODUCTS	--	--	--	--	--	--
5	METALLIC ORES & CONCENTRATES	--	--	32.3	0.1	--	--
6	MINERALS FUELS	131.3	0.3	454.8	15.7	87.2	80.3
7	NON-METALLIC MINERALS	5.2	--	--	--	--	--
8	SERVICES INCIDENTAL TO MINING	--	--	--	--	--	--
9	MEAT,FISH & DAIRY PRODUCTS	--	--	--	0.9	3.8	--
10	FRUIT,VEG.,FEED,MISC.FOOD PROD	2.0	--	--	3.7	--	--
11	BEVERAGES	--	--	--	--	--	--
12	TOBACCO & TOBACCO PRODUCTS	--	--	--	0.6	--	--
13	RUBBER,LEATHER,PLASTIC FAB.PRO	96.7	0.4	--	37.3	33.9	--
14	TEXTILE PRODUCTS	12.4	3.0	--	17.3	3.2	--
15	KNITTED PRODUCTS & CLOTHING	--	--	--	--	18.3	--
16	LUMBER,SAWMILL,OTHER WOOD PROD	--	--	--	34.9	6.7	--
17	FURNITURE & FIXTURES	--	--	--	--	--	--
18	PAPER & PAPER PRODUCTS	8.8	--	--	99.7	268.9	--
19	PRINTING & PUBLISHING	7.2	36.4	2.7	18.8	19.4	65.2
20	PRIMARY METAL PRODUCTS	27.1	--	--	3.5	--	--
21	METAL FABRICATED PRODUCTS	14.7	--	--	72.8	27.0	--
22	MACHINERY & EQUIPMENT	4.2	--	--	--	--	--
23	AUTOS,TRUCKS,OTHER TRANSP. EQP	501.4	--	--	--	--	--
24	ELEC. & COMMUNICATIONS PROD.	37.1	143.5	--	0.3	--	--
25	NON-METALLIC MINERAL PRODUCTS	13.5	--	--	3.2	3.4	--
26	PETROLEUM & COAL PRODUCTS	1061.9	20.9	231.6	203.0	166.5	67.6
27	CHEMICALS,CHEMICAL PROD.	14.4	2.4	--	22.3	19.3	--
28	MISC. MANUFACTURED PRODUCTS	9.9	15.0	--	7.8	11.1	--
29	RESIDENTIAL CONSTRUCTION	--	--	--	--	--	--
30	NON-RESIDENTIAL CONSTRUCTION	--	--	--	--	--	--
31	REPAIR CONSTRUCTION	539.0	142.8	222.7	19.1	84.0	2776.6
32	TRANSPORTATION & STORAGE	1657.5	140.0	52.3	279.3	184.0	32.9
33	COMMUNICATION SERVICES	270.3	188.6	21.6	297.9	321.2	561.4
34	OTHER UTILITIES	109.6	24.3	53.6	74.2	322.1	201.7
35	WHOLESALE MARGINS	213.3	11.4	9.6	229.6	62.8	17.6
36	RETAIL MARGINS	80.4	43.3	0.7	29.1	22.6	4.8
37	IMPUTED RENT OWNER OCPD. DWEL.	--	--	--	--	--	--
38	OTHER FINANCE,INS.,REAL ESTATE	474.3	85.1	111.7	685.6	1355.9	2986.9
39	BUSINESS SERVICES	150.7	117.3	42.0	289.4	220.0	697.1
40	PERSONAL & OTHER MISC. SERVICE	526.2	149.9	32.0	107.4	120.1	171.5
41	TRANSPORTATION MARGINS	57.6	4.2	30.3	23.9	23.5	4.4
42	OPERATING,OFFICE,LAB & FOOD	641.5	137.9	84.2	366.5	493.0	868.9
43	TRAVEL, ADVERTISING, PROMOTION	241.8	99.8	28.3	714.7	646.2	626.1
44	NON-COMPETING IMPORTS	--	--	--	--	36.8	--
45	UNALLOCATED IMPORTS & EXPORTS	--	--	--	--	--	--
46	NET INDIRECT TAXES	393.2	-155.8	48.8	193.8	440.9	5696.6
47	LABOUR INCOME	6357.8	3355.6	1452.6	6450.8	8797.0	7464.5
48	NET INCOME UNINC. BUSINESS	362.7	2.6	8.0	393.2	1376.1	1110.9
49	OTHER OPERATING SURPLUS	2209.7	1771.6	3501.1	1744.6	2076.6	14597.3
	TOTAL	16237.9	6340.6	6421.1	12453.3	17601.0	38032.1

NOTE: DETAIL MAY NOT ADD DUE TO ROUNDING.

TABLE 02. USE (INPUT) MATRIX (AGGREGATION - S), 1977 (MILLIONS OF DOLLARS) - CONCLUDED

NO.	COMMODITY AGGREGATION - S	BUSINESS & PERSONAL SERVICES	TRANS. MARGINS	OPERATING OFFICE SUPPLIES	TRAVEL, PROMOTION, ADVTG.	TOTAL INDUSTRIES
1	GRAINS	--	--	--	--	824.1
2	OTHER AGRICULTURAL PRODUCTS	146.5	--	77.9	--	6151.1
3	FORESTRY PRODUCTS	--	--	--	--	3077.4
4	FISHING & TRAPPING PRODUCTS	11.2	--	3.3	--	523.2
5	METALLIC ORES & CONCENTRATES	3.1	--	--	--	2600.5
6	MINERALS FUELS	21.2	--	--	--	9519.6
7	NON-METALLIC MINERALS	3.0	--	0.6	--	631.2
8	SERVICES INCIDENTAL TO MINING	--	--	--	--	1394.9
9	MEAT,FISH & DAIRY PRODUCTS	1244.8	--	265.6	--	3305.6
10	FRUIT,VEG.,FEED,MISC.FOOD PROD	378.7	--	167.2	--	3488.0
11	BEVERAGES	39.4	--	24.3	52.8	248.8
12	TOBACCO & TOBACCO PRODUCTS	--	--	--	--	203.4
13	RUBBER,LEATHER,PLASTIC FAB.PRO	16.7	--	498.0	4.8	2437.4
14	TEXTILE PRODUCTS	108.0	--	68.6	--	2878.8
15	KNITTED PRODUCTS & CLOTHING	5.4	--	28.1	--	316.6
16	LUMBER,SAWMILL,OTHER WOOD PROD	30.6	--	10.7	--	3758.7
17	FURNITURE & FIXTURES	3.5	--	--	--	105.3
18	PAPER & PAPER PRODUCTS	123.0	--	465.1	3.9	4493.5
19	PRINTING & PUBLISHING	30.0	--	909.7	1342.8	2782.4
20	PRIMARY METAL PRODUCTS	7.8	--	50.1	--	7479.3
21	METAL FABRICATED PRODUCTS	12.5	--	762.2	--	7256.1
22	MACHINERY & EQUIPMENT	0.3	--	1267.9	--	3038.7
23	AUTOS,TRUCKS,OTHER TRANSP. EQP	--	--	700.1	65.6	8293.2
24	ELEC. & COMMUNICATIONS PROD.	1.6	--	463.0	6.4	3415.6
25	NON-METALLIC MINERAL PRODUCTS	14.6	--	67.1	--	3315.7
26	PETROLEUM & COAL PRODUCTS	224.5	--	15.7	198.2	5071.2
27	CHEMICALS,CHEMICAL PROD.	139.5	--	538.3	3.4	6105.2
28	MISC. MANUFACTURED PRODUCTS	180.8	--	360.7	101.5	1609.7
29	RESIDENTIAL CONSTRUCTION	--	--	--	--	--
30	NON-RESIDENTIAL CONSTRUCTION	--	--	--	--	--
31	REPAIR CONSTRUCTION	56.4	--	--	--	5048.8
32	TRANSPORTATION & STORAGE	80.1	6482.5	--	1190.2	11628.8
33	COMMUNICATION SERVICES	400.7	--	--	655.4	3409.7
34	OTHER UTILITIES	201.8	--	--	--	2837.8
35	WHOLESALE MARGINS	246.3	--	1347.2	95.7	6379.2
36	RETAIL MARGINS	170.0	--	454.1	88.1	1179.0
37	IMPUTED RENT OWNER OCPD. DWEL.	--	--	--	--	--
38	OTHER FINANCE,INS.,REAL ESTATE	1364.3	--	--	--	12857.3
39	BUSINESS SERVICES	591.0	--	--	586.6	5620.6
40	PERSONAL & OTHER MISC. SERVICE	570.7	--	2180.7	1428.1	6523.9
41	TRANSPORTATION MARGINS	76.9	--	234.8	26.7	3175.2
42	OPERATING,OFFICE,LAB & FOOD	1219.6	--	--	--	9668.7
43	TRAVEL, ADVERTISING, PROMOTION	680.9	--	--	--	5592.2
44	NON-COMPETING IMPORTS	16.6	--	6.4	--	789.8
45	UNALLOCATED IMPORTS & EXPORTS	--	--	78.0	366.6	444.6
46	NET INDIRECT TAXES	291.9	--	971.1	434.3	10188.8
47	LABOUR INCOME	9357.6	--	--	--	86520.0
48	NET INCOME UNINC. BUSINESS	4458.2	--	--	--	12204.2
49	OTHER OPERATING SURPLUS	3195.1	--	--	--	52899.6
	TOTAL	25725.0	6482.5	12016.6	6651.0	331293.2

NOTE: DETAIL MAY NOT ADD DUE TO ROUNDING.

TABLE 03. FINAL DEMAND MATRIX (AGGREGATION - S), 1977 (MILLIONS OF DOLLARS)

NO.	COMMODITY AGGREGATION - S	CONS. EXP DURABLE	CONS. EXP SEMI DURABLE	CONS. EXP NON DURABLE	CONS. EXP SERVICES	CONS-TRUCTION BUSINESS	CONS-TRUCTION GOVERNMENT	MACHINERY EQUIPMENT BUSINESS	MACHINERY EQUIPMENT GOVERNMENT
1	GRAINS	..	..	..	..	..	..	..	..
2	OTHER AGRICULTURAL PRODUCTS	..	23.7	1502.5	49.2	..	..	..	..
3	FORESTRY PRODUCTS	..	..	53.0	..	..	..	..	..
4	FISHING & TRAPPING PRODUCTS	..	..	30.3	..	..	..	..	..
5	METALLIC ORES & CONCENTRATES	..	..	..	..	..	..	..	..
6	MINERALS FUELS	..	..	299.0	31.0	..	..	..	..
7	NON-METALLIC MINERALS	..	3.5	22.3	..	..	..	..	..
8	SERVICES INCIDENTAL TO MINING	..	..	..	..	..	..	..	..
9	MEAT,FISH & DAIRY PRODUCTS	..	..	5706.6	..	..	..	..	..
10	FRUIT,VEG.,FEED,MISC.FOOD PROD.	..	..	4886.6	..	..	..	..	..
11	BEVERAGES	..	..	2021.9	..	..	..	..	..
12	TOBACCO & TOBACCO PRODUCTS	..	..	720.0	..	..	..	..	..
13	RUBBER,LEATHER,PLASTIC FAB.PRO	275.7	1064.8	73.4	..	..	..	22.2	5.1
14	TEXTILE PRODUCTS	380.9	575.9	83.9	10.9	..	..	14.8	1.7
15	KNITTED PRODUCTS & CLOTHING	..	3898.2	..	..	..	..	..	..
16	LUMBER,SAWMILL,OTHER WOOD PROD.	43.2	125.7	2.7	..	..	..	26.3	0.5
17	FURNITURE & FIXTURES	1227.7	39.8	..	..	..	..	287.7	84.1
18	PAPER & PAPER PRODUCTS	..	49.8	529.7	..	..	..	..	..
19	PRINTING & PUBLISHING	..	1018.4	..	66.5	..	..	..	..
20	PRIMARY METAL PRODUCTS	..	3.1	..	..	..	..	-132.0	..
21	METAL FABRICATED PRODUCTS	102.7	397.7	19.3	..	..	..	407.2	42.0
22	MACHINERY & EQUIPMENT	112.1	51.7	..	..	..	..	5061.6	97.3
23	AUTOS,TRUCKS,OTHER TRANSP. EQP.	4929.8	..	..	..	180.9	..	3134.6	387.1
24	ELEC. & COMMUNICATIONS PROD.	1972.7	162.6	..	..	..	..	2545.1	71.5
25	NON-METALLIC MINERAL PRODUCTS	..	225.4	..	..	..	..	28.0	0.5
26	PETROLEUM & COAL PRODUCTS	..	1.3	2843.6	62.4	..	..	..	..
27	CHEMICALS,CHEMICAL PROD	32.6	113.7	1394.8	..	..	..	71.4	..
28	MISC. MANUFACTURED PRODUCTS	1185.1	702.5	171.3	13.4	..	..	257.6	127.3
29	RESIDENTIAL CONSTRUCTION	..	..	..	..	10790.6	32.0	..	..
30	NON-RESIDENTIAL CONSTRUCTION	..	..	..	..	13222.7	5757.4	..	..
31	REPAIR CONSTRUCTION	..	..	..	66.4	..	..	..	..
32	TRANSPORTATION & STORAGE	..	..	180.7	2515.5	..	..	..	..
33	COMMUNICATION SERVICES	..	..	..	2163.1	..	..	..	..
34	OTHER UTILITIES	..	..	2347.9	582.0	..	..	..	..
35	WHOLESALE MARGINS	1171.1	794.0	2129.4	23.9	19.8	..	1856.4	69.0
36	RETAIL MARGINS	3369.4	4112.0	5143.1	20.8	19.9	..	310.8	20.7
37	IMPUTED RENT OWNER OCPD. DWEL.	..	..	..	11449.5	..	..	..	..
38	OTHER FINANCE,INS.,REAL ESTATE	..	..	..	11961.9	2023.0	..	..	..
39	BUSINESS SERVICES	..	..	..	590.7	..	..	..	..
40	PERSONAL & OTHER MISC. SERVICE	1608.8	119.0	..	14411.9	..	..	..	..
41	TRANSPORTATION MARGINS	222.3	264.5	560.9	6.3	3.4	..	277.5	17.4
42	OPERATING,OFFICE,LAB & FOOD	..	..	..	366.9	..	..	..	..
43	TRAVEL, ADVERTISING, PROMOTION	..	..	..	215.7	..	..	..	..
44	NON-COMPETING IMPORTS	..	..	178.6	..	..	..	..	..
45	UNALLOCATED IMPORTS & EXPORTS	..	..	..	1360.0	..	..	..	..
46	NET INDIRECT TAXES	2253.7	1098.6	5728.0	754.5	18.1	..	946.5	56.8
47	LABOUR INCOME	..	..	..	4404.6	..	..	..	..
48	NET INCOME UNINC. BUSINESS	..	..	..	..	..	..	..	..
49	OTHER OPERATING SURPLUS	..	..	..	288.2	..	..	..	..
	TOTAL	18867.7	14773.9	36408.6	51395.4	26278.5	5789.4	15105.6	981.0

NOTE: DETAIL MAY NOT ADD DUE TO ROUNDING.

TABLE 03. FINAL DEMAND MATRIX (AGGREGATION - S), 1977 (MILLIONS OF DOLLARS) - CONCLUDED

NO.	COMMODITY AGGREGATION - S	INVEN-TORIES	DOMESTIC EXPORTS	RE-EXPORTS	IMPORTS	GOVT GROSS CURRENT EXPEND.	GOVT. SALE OF GOOD & SERVICES	FINAL EXPEND. ON GDP
1	GRAINS	72.2	1896.9	0.4	-65.9	..	..	1903.5
2	OTHER AGRICULTURAL PRODUCTS	-70.9	701.0	2.6	-841.8	35.2	-14.0	1387.6
3	FORESTRY PRODUCTS	-50.6	67.3	0.1	-68.4	..	..	1.4
4	FISHING & TRAPPING PRODUCTS	1.3	144.8	1.7	-173.2	..	-0.8	4.2
5	METALLIC ORES & CONCENTRATES	90.7	2323.3	0.5	-580.8	6.1	..	1839.8
6	MINERALS FUELS	97.6	3580.8	..	-4227.6	79.6	-89.3	-248.8
7	NON-METALLIC MINERALS	13.4	706.4	6.0	-202.3	64.3	-0.4	612.2
8	SERVICES INCIDENTAL TO MINING	..	..	..	..	..	-0.6	-0.6
9	MEAT,FISH & DAIRY PRODUCTS	20.5	1147.6	9.1	-638.8	0.3	-1.7	6242.5
10	FRUIT,VEG.,FEED,MISC.FOOD PROD.	1.4	570.5	24.4	-1220.4	..	-0.1	4242.4
11	BEVERAGES	-26.1	319.0	0.3	-343.9	..	..	1971.2
12	TOBACCO & TOBACCO PRODUCTS	-51.0	59.5	0.4	-28.1	..	..	700.7
13	RUBBER,LEATHER,PLASTIC FAB.PRO	33.4	280.4	13.3	-1326.8	0.7	..	432.4
14	TEXTILE PRODUCTS	-19.6	170.4	13.6	-1372.4	36.6	..	-123.2
15	KNITTED PRODUCTS & CLOTHING	-220.1	127.6	7.3	-817.6	27.6	-3.5	2967.5
16	LUMBER,SAWMILL,OTHER WOOD PROD.	-69.1	2716.9	4.0	-430.9	..	-30.6	2388.6
17	FURNITURE & FIXTURES	-15.8	88.7	2.2	-255.7	9.0	..	1467.6
18	PAPER & PAPER PRODUCTS	-126.4	4747.0	4.6	-694.5	..	..	4510.2
19	PRINTING & PUBLISHING	20.8	98.3	12.8	-573.7	153.1	-29.7	766.4
20	PRIMARY METAL PRODUCTS	-55.4	3796.0	47.1	-1442.8	..	-2.1	2213.9
21	METAL FABRICATED PRODUCTS	-171.1	696.0	35.7	-1767.6	55.4	..	-183.7
22	MACHINERY & EQUIPMENT	-308.7	1761.8	232.2	-5678.1	34.5	-2.3	1352.2
23	AUTOS,TRUCKS,OTHER TRANSP. EQP.	258.9	10925.7	233.1	-12696.4	438.1	-2.3	7789.5
24	ELEC. & COMMUNICATIONS PROD.	-90.9	764.5	68.3	-3188.3	81.3	..	2386.7
25	NON-METALLIC MINERAL PRODUCTS	-83.5	246.5	3.3	-630.3	..	..	-210.1
26	PETROLEUM & COAL PRODUCTS	473.3	756.1	12.7	-332.6	424.4	-3.7	4236.5
27	CHEMICALS,CHEMICAL PROD	-14.5	1376.0	38.0	-2415.2	316.9	-44.2	869.7
28	MISC. MANUFACTURED PRODUCTS	6.5	339.2	75.6	-2382.4	172.6	-38.4	630.3
29	RESIDENTIAL CONSTRUCTION	..	..	..	..	..	..	10822.6
30	NON-RESIDENTIAL CONSTRUCTION	..	..	..	..	86.2	..	19066.3
31	REPAIR CONSTRUCTION	..	..	..	..	1113.0	..	1179.4
32	TRANSPORTATION & STORAGE	..	1305.4	..	-397.6	671.5	-110.3	4166.1
33	COMMUNICATION SERVICES	..	71.7	..	-96.5	416.0	-15.2	2540.1
34	OTHER UTILITIES	..	417.0	..	-15.2	583.5	-469.1	3446.1
35	WHOLESALE MARGINS	..	1519.3	1.0	-256.0	165.2	-9.5	7483.6
36	RETAIL MARGINS	..	..	..	..	90.6	..	13087.4
37	IMPUTED RENT OWNER OCPD. DWEL.	..	..	..	..	..	..	11449.5
38	OTHER FINANCE,INS.,REAL ESTATE	..	180.6	..	-746.4	856.1	-523.2	13743.0
39	BUSINESS SERVICES	..	420.6	..	-1209.2	1505.9	-120.0	1188.1
40	PERSONAL & OTHER MISC. SERVICE	..	39.8	..	-41.6	4028.9	-2144.5	18022.3
41	TRANSPORTATION MARGINS	..	1880.4	11.8	..	62.9	..	3307.3
42	OPERATING,OFFICE,LAB & FOOD	..	..	..	..	1980.9	..	2347.9
43	TRAVEL, ADVERTISING, PROMOTION	..	..	..	..	843.1	..	1058.8
44	NON-COMPETING IMPORTS	11.8	..	0.1	-980.4	..	..	-789.8
45	UNALLOCATED IMPORTS & EXPORTS	..	3231.2	7.5	-5033.2	..	..	-444.6
46	NET INDIRECT TAXES	..	477.5	..	2235.0	162.4	..	13731.2
47	LABOUR INCOME	..	..	..	..	29566.6	..	33971.2
48	NET INCOME UNINC. BUSINESS	..	..	..	..	..	..	..
49	OTHER OPERATING SURPLUS	..	..	..	..	3167.1	..	3455.3
	TOTAL	-271.9	49928.7	849.7	-50935.6	47234.6	-3655.2	212970.3

NOTE: DETAIL MAY NOT ADD DUE TO ROUNDING.

TABLE 04. IMPACT (INVERSE) MATRIX (AGGREGATION - S), 1977

NO.	COMMODITY AGGREGATION - S	AGRICUL-TURE	FORES-TRY	FISHING, HUNTING & TRAPPING	MINES QUARRIES & OIL WELLS	MANUFAC-TURING	CONSTRUC-TION
1	GRAINS	1.0593	0.0077	0.0009	0.0289	0.3040	0.0322
2	OTHER AGRICULTURAL PRODUCTS	1.0520	0.0120	0.0009	0.0290	0.3060	0.0322
3	FORESTRY PRODUCTS	0.0412	1.0617	0.0007	0.0195	0.2131	0.0302
4	FISHING & TRAPPING PRODUCTS	0.0103	0.0053	1.0081	0.0205	0.2112	0.0177
5	METALLIC ORES & CONCENTRATES	0.0107	0.0051	0.0007	0.9837	0.2071	0.0419
6	MINERALS FUELS	0.0071	0.0033	0.0004	1.0414	0.1308	0.0435
7	NON-METALLIC MINERALS	0.0088	0.0042	0.0005	1.0134	0.1679	0.0427
8	SERVICES INCIDENTAL TO MINING	0.0067	0.0031	0.0004	1.0479	0.1223	0.0437
9	MEAT,FISH & DAIRY PRODUCTS	0.0752	0.0321	0.0044	0.0894	1.3221	0.0172
10	FRUIT,VEG.,FEED,MISC.FOOD PROD	0.0672	0.0333	0.0042	0.0924	1.3704	0.0170
11	BEVERAGES	0.0651	0.0336	0.0042	0.0933	1.3839	0.0170
12	TOBACCO & TOBACCO PRODUCTS	0.0651	0.0336	0.0042	0.0932	1.3822	0.0170
13	RUBBER,LEATHER,PLASTIC FAB.PRO	0.0649	0.0335	0.0042	0.0930	1.3794	0.0170
14	TEXTILE PRODUCTS	0.0647	0.0334	0.0042	0.0927	1.3747	0.0170
15	KNITTED PRODUCTS & CLOTHING	0.0651	0.0336	0.0042	0.0932	1.3833	0.0170
16	LUMBER,SAWMILL,OTHER WOOD PROD	0.0648	0.0406	0.0042	0.0928	1.3755	0.0171
17	FURNITURE & FIXTURES	0.0649	0.0335	0.0042	0.0929	1.3777	0.0170
18	PAPER & PAPER PRODUCTS	0.0651	0.0336	0.0042	0.0932	1.3834	0.0170
19	PRINTING & PUBLISHING	0.0651	0.0336	0.0042	0.0932	1.3823	0.0170
20	PRIMARY METAL PRODUCTS	0.0651	0.0336	0.0042	0.0934	1.3837	0.0170
21	METAL FABRICATED PRODUCTS	0.0650	0.0336	0.0042	0.0931	1.3810	0.0170
22	MACHINERY & EQUIPMENT	0.0645	0.0333	0.0042	0.1035	1.3704	0.0173
23	AUTOS,TRUCKS,OTHER TRANSP. EQP	0.0644	0.0332	0.0042	0.0924	1.3681	0.0174
24	ELEC. & COMMUNICATIONS PROD.	0.0619	0.0320	0.0040	0.0888	1.3153	0.0176
25	NON-METALLIC MINERAL PRODUCTS	0.0649	0.0335	0.0042	0.0972	1.3779	0.0171
26	PETROLEUM & COAL PRODUCTS	0.0621	0.0320	0.0040	0.1421	1.3187	0.0184
27	CHEMICALS,CHEMICAL PROD	0.0621	0.0320	0.0040	0.1436	1.3172	0.0184
28	MISC. MANUFACTURED PRODUCTS	0.0633	0.0326	0.0041	0.0906	1.3423	0.0168
29	RESIDENTIAL CONSTRUCTION	0.0190	0.0100	0.0012	0.0562	0.3798	1.0097
30	NON-RESIDENTIAL CONSTRUCTION	0.0190	0.0100	0.0012	0.0562	0.3798	1.0097
31	REPAIR CONSTRUCTION	0.0190	0.0100	0.0012	0.0562	0.3798	1.0097
32	TRANSPORTATION & STORAGE	0.0099	0.0050	0.0006	0.0242	0.1845	0.0445
33	COMMUNICATION SERVICES	0.0041	0.0019	0.0002	0.0068	0.0729	0.0275
34	OTHER UTILITIES	0.0046	0.0023	0.0003	0.0554	0.0910	0.0401
35	WHOLESALE MARGINS	0.0177	0.0090	0.0011	0.0262	0.3455	0.0120
36	RETAIL MARGINS	0.0224	0.0024	0.0003	0.0122	0.0902	0.0155
37	IMPUTED RENT OWNER OCPD. DWEL.	0.0034	0.0016	0.0002	0.0091	0.0616	0.0818
38	OTHER FINANCE,INS.,REAL ESTATE	0.0042	0.0019	0.0002	0.0157	0.0708	0.0858
39	BUSINESS SERVICES	0.0151	0.0046	0.0009	0.0156	0.1849	0.0119
40	PERSONAL & OTHER MISC. SERVICE	0.0157	0.0070	0.0010	0.0173	0.1754	0.0200
41	TRANSPORTATION MARGINS	0.0096	0.0048	0.0006	0.0234	0.1784	0.0430
42	OPERATING,OFFICE,LAB & FOOD	0.0335	0.0136	0.0019	0.0402	0.5378	0.0121
43	TRAVEL, ADVERTISING, PROMOTION	0.0210	0.0102	0.0013	0.0318	0.3937	0.0195

TABLE 04. IMPACT (INVERSE) MATRIX (AGGREGATION - S), 1977 - CONTINUED

NO.	COMMODITY AGGREGATION - S	TRANS. & STORAGE	COMMUNI-CATION	ELEC POWER GAS,OTHER UTILITIES	WHOLESALE TRADE	RETAIL TRADE	FINANCE, INS. & REAL EST.
1	GRAINS	0.0313	0.0116	0.0203	0.0368	0.0099	0.0550
2	OTHER AGRICULTURAL PRODUCTS	0.0318	0.0116	0.0202	0.0368	0.0107	0.0551
3	FORESTRY PRODUCTS	0.1367	0.0106	0.0077	0.0312	0.0172	0.0626
4	FISHING & TRAPPING PRODUCTS	0.0248	0.0062	0.0044	0.0287	0.0075	0.0235
5	METALLIC ORES & CONCENTRATES	0.0261	0.0100	0.0190	0.0210	0.0086	0.1952
6	MINERALS FUELS	0.0244	0.0097	0.0190	0.0203	0.0086	0.2048
7	NON-METALLIC MINERALS	0.0252	0.0098	0.0190	0.0207	0.0086	0.2002
8	SERVICES INCIDENTAL TO MINING	0.0242	0.0096	0.0190	0.0202	0.0086	0.2059
9	MEAT,FISH & DAIRY PRODUCTS	0.0510	0.0148	0.0193	0.0311	0.0462	0.0490
10	FRUIT,VEG.,FEED,MISC.FOOD PROD	0.0519	0.0145	0.0192	0.0351	0.0136	0.0478
11	BEVERAGES	0.0521	0.0144	0.0193	0.0318	0.0086	0.0475
12	TOBACCO & TOBACCO PRODUCTS	0.0521	0.0144	0.0193	0.0331	0.0087	0.0475
13	RUBBER,LEATHER,PLASTIC FAB.PRO	0.0521	0.0144	0.0192	0.0353	0.0087	0.0475
14	TEXTILE PRODUCTS	0.0521	0.0145	0.0192	0.0376	0.0099	0.0476
15	KNITTED PRODUCTS & CLOTHING	0.0521	0.0144	0.0193	0.0320	0.0088	0.0475
16	LUMBER,SAWMILL,OTHER WOOD PROD	0.0527	0.0144	0.0192	0.0322	0.0087	0.0477
17	FURNITURE & FIXTURES	0.0521	0.0145	0.0192	0.0366	0.0087	0.0476
18	PAPER & PAPER PRODUCTS	0.0521	0.0144	0.0193	0.0322	0.0086	0.0475
19	PRINTING & PUBLISHING	0.0521	0.0144	0.0193	0.0330	0.0087	0.0475
20	PRIMARY METAL PRODUCTS	0.0521	0.0144	0.0193	0.0318	0.0086	0.0475
21	METAL FABRICATED PRODUCTS	0.0521	0.0144	0.0193	0.0341	0.0087	0.0475
22	MACHINERY & EQUIPMENT	0.0518	0.0143	0.0193	0.0317	0.0086	0.0492
23	AUTOS,TRUCKS,OTHER TRANSP. EQP	0.0659	0.0145	0.0192	0.0321	0.0087	0.0475
24	ELEC. & COMMUNICATIONS PROD.	0.0512	0.0668	0.0186	0.0317	0.0089	0.0462
25	NON-METALLIC MINERAL PRODUCTS	0.0520	0.0144	0.0193	0.0324	0.0087	0.0481
26	PETROLEUM & COAL PRODUCTS	0.0512	0.0141	0.0193	0.0312	0.0086	0.0556
27	CHEMICALS,CHEMICAL PROD	0.0507	0.0141	0.0193	0.0312	0.0086	0.0558
28	MISC. MANUFACTURED PRODUCTS	0.0519	0.0150	0.0189	0.0610	0.0087	0.0481
29	RESIDENTIAL CONSTRUCTION	0.0431	0.0114	0.0076	0.0479	0.0128	0.0413
30	NON-RESIDENTIAL CONSTRUCTION	0.0431	0.0114	0.0076	0.0479	0.0128	0.0413
31	REPAIR CONSTRUCTION	0.0431	0.0114	0.0076	0.0479	0.0128	0.0413
32	TRANSPORTATION & STORAGE	1.1244	0.0256	0.0135	0.0252	0.0167	0.0491
33	COMMUNICATION SERVICES	0.0342	1.0358	0.0059	0.0092	0.0137	0.0231
34	OTHER UTILITIES	0.0211	0.0066	1.0001	0.0078	0.0035	0.0329
35	WHOLESALE MARGINS	0.0485	0.0312	0.0107	0.8287	0.0099	0.0635
36	RETAIL MARGINS	0.0291	0.0264	0.0240	0.0115	0.9943	0.0867
37	IMPUTED RENT OWNER OCPD. DWEL.	0.0115	0.0204	0.0069	0.0089	0.0050	1.0866
38	OTHER FINANCE,INS.,REAL ESTATE	0.0144	0.0205	0.0076	0.0113	0.0076	1.0583
39	BUSINESS SERVICES	0.0280	0.0322	0.0116	0.0248	0.0175	0.0720
40	PERSONAL & OTHER MISC. SERVICE	0.0331	0.0255	0.0158	0.0627	0.1392	0.0980
41	TRANSPORTATION MARGINS	1.0870	0.0248	0.0131	0.0243	0.0162	0.0474
42	OPERATING,OFFICE,LAB & FOOD	0.0512	0.0153	0.0116	0.1140	0.0660	0.0443
43	TRAVEL, ADVERTISING, PROMOTION	0.2232	0.1161	0.0116	0.0387	0.0482	0.0482

TABLE 04. IMPACT (INVERSE) MATRIX (AGGREGATION - S), 1977 - CONCLUDED

NO.	COMMODITY AGGREGATION - S	BUSINESS & PERSONAL SERVICES	TRANS. MARGINS	OPERATING OFFICE SUPPLIES	TRAVEL, PROMOTION, ADVTG.	TOTAL INDUSTRIES
1	GRAINS	0.0227	0.0187	0.0440	0.0111	1.6945
2	OTHER AGRICULTURAL PRODUCTS	0.0229	0.0187	0.0445	0.0112	1.6957
3	FORESTRY PRODUCTS	0.0619	0.0111	0.1606	0.0145	1.9005
4	FISHING & TRAPPING PRODUCTS	0.0224	0.0133	0.0270	0.0078	1.4386
5	METALLIC ORES & CONCENTRATES	0.0466	0.0097	0.0635	0.0158	1.6847
6	MINERALS FUELS	0.0470	0.0085	0.0650	0.0147	1.6686
7	NON-METALLIC MINERALS	0.0468	0.0091	0.0643	0.0153	1.6764
8	SERVICES INCIDENTAL TO MINING	0.0470	0.0084	0.0652	0.0146	1.6668
9	MEAT,FISH & DAIRY PRODUCTS	0.0406	0.0262	0.0601	0.0333	1.9120
10	FRUIT,VEG.,FEED,MISC.FOOD PROD	0.0409	0.0269	0.0610	0.0333	1.9288
11	BEVERAGES	0.0410	0.0271	0.0612	0.0332	1.9333
12	TOBACCO & TOBACCO PRODUCTS	0.0410	0.0271	0.0611	0.0332	1.9327
13	RUBBER,LEATHER,PLASTIC FAB.PRO	0.0410	0.0270	0.0611	0.0333	1.9318
14	TEXTILE PRODUCTS	0.0410	0.0270	0.0610	0.0334	1.9301
15	KNITTED PRODUCTS & CLOTHING	0.0410	0.0271	0.0612	0.0332	1.9331
16	LUMBER,SAWMILL,OTHER WOOD PROD	0.0411	0.0270	0.0618	0.0331	1.9329
17	FURNITURE & FIXTURES	0.0410	0.0270	0.0611	0.0333	1.9312
18	PAPER & PAPER PRODUCTS	0.0410	0.0271	0.0612	0.0332	1.9331
19	PRINTING & PUBLISHING	0.0410	0.0271	0.0612	0.0332	1.9328
20	PRIMARY METAL PRODUCTS	0.0410	0.0271	0.0612	0.0332	1.9333
21	METAL FABRICATED PRODUCTS	0.0410	0.0271	0.0611	0.0332	1.9323
22	MACHINERY & EQUIPMENT	0.0410	0.0269	0.0614	0.0330	1.9304
23	AUTOS,TRUCKS,OTHER TRANSP. EQP	0.0412	0.0269	0.0611	0.0331	1.9296
24	ELEC. & COMMUNICATIONS PROD.	0.0413	0.0259	0.0596	0.0326	1.9023
25	NON-METALLIC MINERAL PRODUCTS	0.0410	0.0270	0.0613	0.0331	1.9319
26	PETROLEUM & COAL PRODUCTS	0.0413	0.0262	0.0624	0.0322	1.9195
27	CHEMICALS,CHEMICAL PROD	0.0413	0.0261	0.0624	0.0322	1.9192
28	MISC. MANUFACTURED PRODUCTS	0.0447	0.0264	0.0606	0.0341	1.9192
29	RESIDENTIAL CONSTRUCTION	0.0603	0.0224	0.0398	0.0187	1.7810
30	NON-RESIDENTIAL CONSTRUCTION	0.0603	0.0224	0.0398	0.0187	1.7810
31	REPAIR CONSTRUCTION	0.0603	0.0224	0.0398	0.0187	1.7810
32	TRANSPORTATION & STORAGE	0.0568	0.0096	0.0589	0.0256	1.6741
33	COMMUNICATION SERVICES	0.0470	0.0034	0.0308	0.0211	1.3376
34	OTHER UTILITIES	0.0224	0.0078	0.0238	0.0088	1.3285
35	WHOLESALE MARGINS	0.0615	0.0096	0.0458	0.0589	1.5798
36	RETAIL MARGINS	0.0445	0.0047	0.0390	0.0426	1.4458
37	IMPUTED RENT OWNER OCPD. DWEL.	0.0354	0.0033	0.0319	0.0217	1.3893
38	OTHER FINANCE,INS.,REAL ESTATE	0.0411	0.0036	0.0326	0.0219	1.3974
39	BUSINESS SERVICES	1.0197	0.0062	0.0610	0.0350	1.5431
40	PERSONAL & OTHER MISC. SERVICE	0.8189	0.0078	0.0570	0.0366	1.5311
41	TRANSPORTATION MARGINS	0.0549	1.0093	0.0570	0.0247	2.6184
42	OPERATING,OFFICE,LAB & FOOD	0.1600	0.0314	1.0381	0.0259	2.1970
43	TRAVEL, ADVERTISING, PROMOTION	0.2610	0.0143	0.0436	1.0250	2.3073

TABLE 05. MAKE (OUTPUT) MATRIX (AGGREGATION - S), 1977 (MILLIONS OF 1971 DOLLARS)

NO.	COMMODITY AGGREGATION - S	AGRICUL-TURE	FORES-TRY	FISHING, HUNTING & TRAPPING	MINES QUARRIES & OIL WELLS	MANUFAC-TURING	CONSTRUC-TION
1	GRAINS	1343.3	--	--	--	0.1	--
2	OTHER AGRICULTURAL PRODUCTS	4112.5	16.6	--	--	8.0	--
3	FORESTRY PRODUCTS	40.3	1502.8	--	--	36.9	--
4	FISHING & TRAPPING PRODUCTS	--	--	243.9	--	--	--
5	METALLIC ORES & CONCENTRATES	--	--	--	2251.2	100.0	--
6	MINERALS FUELS	--	--	--	2046.5	17.2	--
7	NON-METALLIC MINERALS	--	--	--	545.8	24.6	--
8	SERVICES INCIDENTAL TO MINING	--	--	--	777.6	--	--
9	MEAT,FISH & DAIRY PRODUCTS	72.3	--	1.4	--	5161.7	--
10	FRUIT,VEG.,FEED,MISC.FOOD PROD	13.1	--	--	--	4045.0	--
11	BEVERAGES	--	--	--	--	1442.3	--
12	TOBACCO & TOBACCO PRODUCTS	--	--	--	--	592.7	--
13	RUBBER,LEATHER,PLASTIC FAB.PRO	--	--	--	--	1795.9	--
14	TEXTILE PRODUCTS	--	--	--	--	1928.2	--
15	KNITTED PRODUCTS & CLOTHING	--	--	--	--	2142.7	--
16	LUMBER,SAWMILL,OTHER WOOD PROD	--	20.6	--	--	3164.3	--
17	FURNITURE & FIXTURES	--	--	--	--	913.7	--
18	PAPER & PAPER PRODUCTS	--	--	--	--	4653.1	--
19	PRINTING & PUBLISHING	--	--	--	--	2228.9	--
20	PRIMARY METAL PRODUCTS	--	--	--	0.8	5230.0	--
21	METAL FABRICATED PRODUCTS	--	--	--	--	4050.9	--
22	MACHINERY & EQUIPMENT	--	0.1	--	27.7	2756.9	--
23	AUTOS,TRUCKS,OTHER TRANSP. EQP	--	--	--	--	10519.7	--
24	ELEC. & COMMUNICATIONS PROD.	--	--	--	--	3750.7	--
25	NON-METALLIC MINERAL PRODUCTS	--	--	--	6.3	1774.4	--
26	PETROLEUM & COAL PRODUCTS	--	--	--	103.8	2942.0	--
27	CHEMICALS,CHEMICAL PROD	--	--	--	200.2	3825.7	--
28	MISC. MANUFACTURED PRODUCTS	--	--	--	--	1395.5	--
29	RESIDENTIAL CONSTRUCTION	--	--	--	--	--	5292.2
30	NON-RESIDENTIAL CONSTRUCTION	--	--	--	--	--	10821.8
31	REPAIR CONSTRUCTION	--	--	--	--	--	3427.7
32	TRANSPORTATION & STORAGE	--	2.2	--	--	10.3	--
33	COMMUNICATION SERVICES	--	--	--	--	--	--
34	OTHER UTILITIES	--	--	--	1.4	27.0	--
35	WHOLESALE MARGINS	--	3.4	--	1.0	1532.4	--
36	RETAIL MARGINS	--	--	--	--	--	--
37	IMPUTED RENT OWNER OCPD. DWEL.	--	--	--	--	--	--
38	OTHER FINANCE,INS.,REAL ESTATE	5.1	0.8	--	108.2	77.7	98.6
39	BUSINESS SERVICES	--	--	--	1.1	107.1	0.2
40	PERSONAL & OTHER MISC. SERVICE	--	33.2	3.1	24.7	254.7	81.5
41	TRANSPORTATION MARGINS	--	--	--	--	--	--
42	OPERATING,OFFICE,LAB & FOOD	--	--	--	--	--	--
43	TRAVEL, ADVERTISING, PROMOTION	--	--	--	--	--	--
	TOTAL	5586.6	1579.9	248.4	6096.5	66510.1	19722.0

NOTE: DETAIL MAY NOT ADD DUE TO ROUNDING.

TABLE 05. MAKE (OUTPUT) MATRIX (AGGREGATION - S), 1977 (MILLIONS OF 1971 DOLLARS) - CONTINUED

NO.	COMMODITY AGGREGATION - S	TRANS. & STORAGE	COMMUNI-CATION	ELEC POWER GAS,OTHER UTILITIES	WHOLESALE TRADE	RETAIL TRADE	FINANCE, INS. & REAL EST.
1	GRAINS	--	--	--	--	--	--
2	OTHER AGRICULTURAL PRODUCTS	--	--	--	--	3.3	--
3	FORESTRY PRODUCTS	--	--	1.3	--	--	--
4	FISHING & TRAPPING PRODUCTS	--	--	--	--	--	--
5	METALLIC ORES & CONCENTRATES	--	--	--	--	--	--
6	MINERALS FUELS	--	--	--	--	--	--
7	NON-METALLIC MINERALS	--	--	--	--	--	--
8	SERVICES INCIDENTAL TO MINING	--	--	--	--	--	--
9	MEAT,FISH & DAIRY PRODUCTS	--	--	--	0.2	248.3	--
10	FRUIT,VEG.,FEED,MISC.FOOD PROD	--	--	--	14.0	11.3	--
11	BEVERAGES	--	--	--	--	--	--
12	TOBACCO & TOBACCO PRODUCTS	--	--	--	0.9	--	--
13	RUBBER,LEATHER,PLASTIC FAB.PRO	--	--	--	6.4	--	--
14	TEXTILE PRODUCTS	--	--	--	12.0	2.6	--
15	KNITTED PRODUCTS & CLOTHING	--	--	--	0.6	0.4	--
16	LUMBER,SAWMILL,OTHER WOOD PROD	--	--	--	1.4	--	--
17	FURNITURE & FIXTURES	--	--	--	4.6	--	--
18	PAPER & PAPER PRODUCTS	--	--	--	2.2	--	--
19	PRINTING & PUBLISHING	--	--	--	2.7	--	--
20	PRIMARY METAL PRODUCTS	--	--	--	--	--	--
21	METAL FABRICATED PRODUCTS	--	--	--	8.6	--	--
22	MACHINERY & EQUIPMENT	--	--	--	--	--	--
23	AUTOS,TRUCKS,OTHER TRANSP. EQP	119.1	--	--	3.7	--	--
24	ELEC. & COMMUNICATIONS PROD.	--	197.9	--	3.8	--	--
25	NON-METALLIC MINERAL PRODUCTS	--	--	--	1.4	--	--
26	PETROLEUM & COAL PRODUCTS	0.9	--	0.1	--	--	--
27	CHEMICALS,CHEMICAL PROD	--	--	--	0.4	--	--
28	MISC. MANUFACTURED PRODUCTS	--	--	--	42.8	--	--
29	RESIDENTIAL CONSTRUCTION	--	--	--	--	--	--
30	NON-RESIDENTIAL CONSTRUCTION	--	--	--	--	--	--
31	REPAIR CONSTRUCTION	--	--	--	--	--	--
32	TRANSPORTATION & STORAGE	9596.9	--	18.4	--	7.7	0.3
33	COMMUNICATION SERVICES	--	4484.4	--	--	--	--
34	OTHER UTILITIES	--	--	3685.0	--	--	--
35	WHOLESALE MARGINS	11.3	--	--	6773.9	--	--
36	RETAIL MARGINS	14.3	--	39.0	--	9099.8	--
37	IMPUTED RENT OWNER OCPD. DWEL.	--	--	--	--	--	7214.6
38	OTHER FINANCE,INS.,REAL ESTATE	34.1	3.2	7.3	31.9	40.6	14897.4
39	BUSINESS SERVICES	21.9	38.0	4.2	59.5	2.7	66.7
40	PERSONAL & OTHER MISC. SERVICE	108.1	20.1	54.6	632.8	1766.6	428.7
41	TRANSPORTATION MARGINS	--	--	--	--	--	--
42	OPERATING,OFFICE,LAB & FOOD	--	--	--	--	--	--
43	TRAVEL, ADVERTISING, PROMOTION	--	--	--	--	--	--
	TOTAL	9906.5	4743.6	3809.9	7603.7	11183.3	22607.7

NOTE: DETAIL MAY NOT ADD DUE TO ROUNDING.

TABLE 05. MAKE (OUTPUT) MATRIX (AGGREGATION - S), 1977 (MILLIONS OF 1971 DOLLARS) - CONCLUDED

NO.	COMMODITY AGGREGATION - S	BUSINESS & PERSONAL SERVICES	TRANS. MARGINS	OPERATING OFFICE SUPPLIES	TRAVEL, PROMOTION, ADVTG.	TOTAL INDUSTRIES
1	GRAINS	--	--	--	--	1343.4
2	OTHER AGRICULTURAL PRODUCTS	--	--	--	--	4140.3
3	FORESTRY PRODUCTS	--	--	--	--	1581.4
4	FISHING & TRAPPING PRODUCTS	--	--	--	--	243.9
5	METALLIC ORES & CONCENTRATES	--	--	--	--	2351.2
6	MINERALS FUELS	--	--	--	--	2063.7
7	NON-METALLIC MINERALS	--	--	--	--	570.5
8	SERVICES INCIDENTAL TO MINING	--	--	--	--	777.6
9	MEAT,FISH & DAIRY PRODUCTS	--	--	--	--	5483.9
10	FRUIT,VEG.,FEED,MISC.FOOD PROD	--	--	--	--	4083.5
11	BEVERAGES	--	--	--	--	1442.3
12	TOBACCO & TOBACCO PRODUCTS	--	--	--	--	593.5
13	RUBBER,LEATHER,PLASTIC FAB.PRO	--	--	--	--	1802.3
14	TEXTILE PRODUCTS	--	--	--	--	1942.7
15	KNITTED PRODUCTS & CLOTHING	--	--	--	--	2143.7
16	LUMBER,SAWMILL,OTHER WOOD PROD	--	--	--	--	3186.3
17	FURNITURE & FIXTURES	--	--	--	--	918.3
18	PAPER & PAPER PRODUCTS	--	--	--	--	4655.3
19	PRINTING & PUBLISHING	--	--	--	--	2231.6
20	PRIMARY METAL PRODUCTS	--	--	--	--	5230.8
21	METAL FABRICATED PRODUCTS	--	--	--	--	4059.5
22	MACHINERY & EQUIPMENT	--	--	--	--	2784.6
23	AUTOS,TRUCKS,OTHER TRANSP. EQP	--	--	--	--	10642.5
24	ELEC. & COMMUNICATIONS PROD.	--	--	--	--	3952.5
25	NON-METALLIC MINERAL PRODUCTS	--	--	--	--	1782.0
26	PETROLEUM & COAL PRODUCTS	--	--	--	--	3047.0
27	CHEMICALS,CHEMICAL PROD.	--	--	--	--	4026.3
28	MISC. MANUFACTURED PRODUCTS	3.5	--	--	--	1441.9
29	RESIDENTIAL CONSTRUCTION	--	--	--	--	5292.2
30	NON-RESIDENTIAL CONSTRUCTION	--	--	--	--	10621.8
31	REPAIR CONSTRUCTION	--	--	--	--	3427.7
32	TRANSPORTATION & STORAGE	--	--	--	--	9635.7
33	COMMUNICATION SERVICES	--	--	--	--	4484.4
34	OTHER UTILITIES	7.0	--	--	--	3720.4
35	WHOLESALE MARGINS	86.1	--	--	--	8408.0
36	RETAIL MARGINS	68.4	--	--	--	9221.6
37	IMPUTED RENT OWNER OCPD. DWEL.	--	--	--	--	7214.6
38	OTHER FINANCE,INS.,REAL ESTATE	92.0	--	--	--	15397.0
39	BUSINESS SERVICES	4894.7	--	--	--	5196.0
40	PERSONAL & OTHER MISC. SERVICE	10749.4	--	--	--	14157.5
41	TRANSPORTATION MARGINS	--	3936.6	--	--	3936.6
42	OPERATING,OFFICE,LAB & FOOD	--	--	7207.4	--	7207.4
43	TRAVEL, ADVERTISING, PROMOTION	--	--	--	4025.2	4025.2
	TOTAL	15901.1	3936.6	7207.4	4025.2	190668.5

NOTE: DETAIL MAY NOT ADD DUE TO ROUNDING.

TABLE 06. USE (INPUT) MATRIX (AGGREGATION - S), 1977 (MILLIONS OF 1971 DOLLARS)

NO.	COMMODITY AGGREGATION - S	AGRICUL-TURE	FORES-TRY	FISHING, HUNTING & TRAPPING	MINES QUARRIES & OIL WELLS	MANUFAC-TURING	CONSTRUC-TION
1	GRAINS	32.2	--	--	--	394.5	--
2	OTHER AGRICULTURAL PRODUCTS	294.8	--	--	--	2808.3	10.7
3	FORESTRY PRODUCTS	0.4	172.2	--	--	1404.6	5.3
4	FISHING & TRAPPING PRODUCTS	--	--	2.7	--	232.7	--
5	METALLIC ORES & CONCENTRATES	--	--	--	8.5	1408.2	--
6	MINERALS FUELS	2.2	--	--	7.5	2064.8	2.2
7	NON-METALLIC MINERALS	5.1	--	0.6	23.1	217.6	80.8
8	SERVICES INCIDENTAL TO MINING	--	--	--	279.8	--	498.2
9	MEAT,FISH & DAIRY PRODUCTS	3.0	--	--	--	1058.5	--
10	FRUIT,VEG.,FEED,MISC.FOOD PROD	604.2	--	--	--	942.1	--
11	BEVERAGES	--	--	--	--	75.7	--
12	TOBACCO & TOBACCO PRODUCTS	--	--	--	--	139.2	--
13	RUBBER,LEATHER,PLASTIC FAB.PRO	11.3	--	--	3.6	812.4	266.8
14	TEXTILE PRODUCTS	14.0	3.7	6.4	1.4	1694.8	125.0
15	KNITTED PRODUCTS & CLOTHING	--	--	--	--	162.3	--
16	LUMBER,SAWMILL,OTHER WOOD PROD	2.5	--	2.6	1.8	814.6	1104.0
17	FURNITURE & FIXTURES	--	--	--	--	44.6	14.9
18	PAPER & PAPER PRODUCTS	2.8	--	--	8.0	1821.0	141.1
19	PRINTING & PUBLISHING	--	--	--	0.3	211.1	--
20	PRIMARY METAL PRODUCTS	--	--	--	75.4	3446.3	475.5
21	METAL FABRICATED PRODUCTS	25.1	13.0	1.1	10.7	1765.2	1856.7
22	MACHINERY & EQUIPMENT	50.8	10.7	3.6	77.5	785.4	191.3
23	AUTOS,TRUCKS,OTHER TRANSP. EQP	1.2	2.6	17.6	7.9	4517.0	42.9
24	ELEC. & COMMUNICATIONS PROD.	--	--	9.5	8.5	1045.7	818.0
25	NON-METALLIC MINERAL PRODUCTS	2.3	0.1	0.5	18.7	648.7	1208.3
26	PETROLEUM & COAL PRODUCTS	205.3	29.5	13.2	81.9	480.8	168.3
27	CHEMICALS,CHEMICAL PROD.	323.3	2.4	0.5	106.6	2306.2	179.7
28	MISC. MANUFACTURED PRODUCTS	--	--	3.5	--	477.1	122.7
29	RESIDENTIAL CONSTRUCTION	--	--	--	--	--	--
30	NON-RESIDENTIAL CONSTRUCTION	--	--	--	--	--	--
31	REPAIR CONSTRUCTION	127.4	24.9	3.7	221.0	277.9	10.0
32	TRANSPORTATION & STORAGE	21.8	184.0	1.5	77.3	491.3	172.6
33	COMMUNICATION SERVICES	44.9	3.9	0.5	25.3	403.9	60.1
34	OTHER UTILITIES	93.0	1.1	0.2	156.3	819.5	12.5
35	WHOLESALE MARGINS	174.8	10.9	7.5	68.2	1222.9	897.9
36	RETAIL MARGINS	27.3	0.9	0.9	3.5	12.0	129.8
37	IMPUTED RENT OWNER OCPD. DWEL.	--	--	--	--	--	--
38	OTHER FINANCE,INS.,REAL ESTATE	245.7	113.0	3.7	557.4	1002.0	358.2
39	BUSINESS SERVICES	16.2	8.5	0.5	285.3	990.2	720.6
40	PERSONAL & OTHER MISC. SERVICE	13.0	58.6	4.0	49.7	289.3	325.2
41	TRANSPORTATION MARGINS	69.6	4.3	2.7	34.3	1216.8	307.7
42	OPERATING,OFFICE,LAB & FOOD	153.5	241.3	4.6	698.4	2099.6	330.2
43	TRAVEL, ADVERTISING, PROMOTION	0.3	4.0	--	50.0	1398.8	100.0
44	NON-COMPETING IMPORTS	--	--	--	--	261.0	--
45	UNALLOCATED IMPORTS & EXPORTS	--	--	--	--	--	--
46	NET INDIRECT TAXES	86.2	34.9	3.5	180.5	625.7	1066.9
	GDP AT FACTOR COST	2932.4	655.6	153.1	2969.1	23619.8	7917.6
	TOTAL	5586.6	1579.9	248.4	6096.5	66510.1	19722.1

NOTE: DETAIL MAY NOT ADD DUE TO ROUNDING.

TABLE 06. USE (INPUT) MATRIX (AGGREGATION - S), 1977 (MILLIONS OF 1971 DOLLARS) - CONTINUED

NO.	COMMODITY AGGREGATION - S	TRANS. & STORAGE	COMMUNI-CATION	ELEC POWER GAS,OTHER UTILITIES	WHOLESALE TRADE	RETAIL TRADE	FINANCE, INS. & REAL EST.
1	GRAINS	--	--	--	5.6	--	--
2	OTHER AGRICULTURAL PRODUCTS	2.3	--	--	0.7	268.4	--
3	FORESTRY PRODUCTS	--	--	--	--	--	--
4	FISHING & TRAPPING PRODUCTS	--	--	--	--	--	--
5	METALLIC ORES & CONCENTRATES	--	--	8.9	--	--	--
6	MINERALS FUELS	24.6	--	122.6	2.8	15.0	13.8
7	NON-METALLIC MINERALS	2.9	--	--	--	--	--
8	SERVICES INCIDENTAL TO MINING	--	--	--	--	--	--
9	MEAT,FISH & DAIRY PRODUCTS	--	--	--	0.5	2.1	--
10	FRUIT,VEG.,FEED,MISC.FOOD PROD	1.1	--	--	2.0	--	--
11	BEVERAGES	--	--	--	--	--	--
12	TOBACCO & TOBACCO PRODUCTS	--	--	--	0.4	--	--
13	RUBBER,LEATHER,PLASTIC FAB.PRO	64.5	0.3	--	24.1	21.3	--
14	TEXTILE PRODUCTS	7.1	1.9	--	10.8	1.8	--
15	KNITTED PRODUCTS & CLOTHING	--	--	--	--	11.7	--
16	LUMBER,SAWMILL,OTHER WOOD PROD	--	--	--	18.8	3.7	--
17	FURNITURE & FIXTURES	--	--	--	--	--	--
18	PAPER & PAPER PRODUCTS	5.2	--	--	58.7	160.8	--
19	PRINTING & PUBLISHING	4.2	21.4	1.5	10.8	11.2	42.0
20	PRIMARY METAL PRODUCTS	14.2	--	--	2.1	--	--
21	METAL FABRICATED PRODUCTS	7.5	--	--	41.7	16.1	--
22	MACHINERY & EQUIPMENT	2.5	--	--	--	--	--
23	AUTOS,TRUCKS,OTHER TRANSP. EQP	300.7	--	--	--	--	--
24	ELEC. & COMMUNICATIONS PROD.	20.9	102.2	--	0.2	--	--
25	NON-METALLIC MINERAL PRODUCTS	8.9	--	--	2.0	2.0	--
26	PETROLEUM & COAL PRODUCTS	354.3	7.3	71.5	83.7	64.4	24.1
27	CHEMICALS,CHEMICAL PROD	7.6	1.3	--	12.5	10.7	--
28	MISC. MANUFACTURED PRODUCTS	6.0	13.5	--	4.2	5.6	--
29	RESIDENTIAL CONSTRUCTION	--	--	--	--	--	--
30	NON-RESIDENTIAL CONSTRUCTION	--	--	--	--	--	--
31	REPAIR CONSTRUCTION	296.6	78.6	122.6	10.5	46.2	1528.1
32	TRANSPORTATION & STORAGE	965.2	84.9	28.4	176.5	114.2	17.9
33	COMMUNICATION SERVICES	215.7	139.3	16.2	228.6	232.2	429.3
34	OTHER UTILITIES	64.3	14.0	32.1	43.5	189.6	120.7
35	WHOLESALE MARGINS	117.0	7.5	4.0	137.8	37.3	9.0
36	RETAIL MARGINS	51.4	27.6	0.4	20.8	16.1	2.8
37	IMPUTED RENT OWNER OCPD. DWEL.	--	--	--	--	--	--
38	OTHER FINANCE,INS.,REAL ESTATE	303.4	55.2	76.2	452.8	871.5	1921.5
39	BUSINESS SERVICES	142.1	89.4	48.5	235.7	203.5	626.9
40	PERSONAL & OTHER MISC. SERVICE	309.4	90.6	17.8	66.5	74.2	107.6
41	TRANSPORTATION MARGINS	35.0	2.5	18.4	14.5	14.3	2.7
42	OPERATING,OFFICE,LAB & FOOD	382.4	83.1	50.8	220.3	288.9	521.5
43	TRAVEL, ADVERTISING, PROMOTION	146.2	60.4	17.6	429.7	404.8	377.2
44	NON-COMPETING IMPORTS	--	--	--	--	7.9	--
45	UNALLOCATED IMPORTS & EXPORTS	--	--	--	--	--	--
46	NET INDIRECT TAXES	401.2	-128.3	83.7	73.5	317.3	3659.5
	GDP AT FACTOR COST	5642.4	3991.0	3088.6	5211.4	7770.3	13202.9
	TOTAL	**9906.5**	**4743.6**	**3089.9**	**7603.7**	**11183.3**	**22607.7**

NOTE: DETAIL MAY NOT ADD DUE TO ROUNDING.

TABLE 06. USE (INPUT) MATRIX (AGGREGATION - S), 1977 (MILLIONS OF 1971 DOLLARS) - CONCLUDED

NO.	COMMODITY AGGREGATION - S	BUSINESS & PERSONAL SERVICES	TRANS. MARGINS	OPERATING OFFICE SUPPLIES	TRAVEL, PROMOTION, ADVTG.	TOTAL INDUSTRIES
1	GRAINS	--	--	--	--	432.3
2	OTHER AGRICULTURAL PRODUCTS	73.8	--	40.2	--	3499.3
3	FORESTRY PRODUCTS	--	--	--	--	1582.4
4	FISHING & TRAPPING PRODUCTS	5.3	--	1.5	--	242.2
5	METALLIC ORES & CONCENTRATES	0.8	--	--	--	1426.4
6	MINERALS FUELS	3.8	--	--	--	2259.2
7	NON-METALLIC MINERALS	1.6	--	0.3	--	332.1
8	SERVICES INCIDENTAL TO MINING	--	--	--	--	778.0
9	MEAT,FISH & DAIRY PRODUCTS	725.3	--	150.0	--	1939.3
10	FRUIT,VEG.,FEED,MISC.FOOD PROD	199.6	--	85.7	--	1834.8
11	BEVERAGES	21.5	--	13.3	37.7	148.2
12	TOBACCO & TOBACCO PRODUCTS	--	--	--	--	139.6
13	RUBBER,LEATHER,PLASTIC FAB.PRO	9.7	--	327.8	3.2	1545.0
14	TEXTILE PRODUCTS	66.9	--	45.6	--	1979.6
15	KNITTED PRODUCTS & CLOTHING	3.5	--	18.5	--	196.0
16	LUMBER,SAWMILL,OTHER WOOD PROD	19.1	--	5.5	--	1972.6
17	FURNITURE & FIXTURES	2.1	--	--	--	61.6
18	PAPER & PAPER PRODUCTS	70.6	--	264.2	2.2	2534.5
19	PRINTING & PUBLISHING	17.8	--	544.9	859.7	1724.9
20	PRIMARY METAL PRODUCTS	2.7	--	27.8	--	4044.0
21	METAL FABRICATED PRODUCTS	6.3	--	417.0	--	4160.4
22	MACHINERY & EQUIPMENT	0.2	--	745.2	--	1867.1
23	AUTOS,TRUCKS,OTHER TRANSP. EQP	--	--	467.6	42.2	5399.5
24	ELEC. & COMMUNICATIONS PROD.	1.2	--	304.7	3.4	2314.5
25	NON-METALLIC MINERAL PRODUCTS	9.1	--	35.2	--	1935.8
26	PETROLEUM & COAL PRODUCTS	71.9	--	5.8	73.2	1735.2
27	CHEMICALS,CHEMICAL PROD	90.8	--	321.5	2.2	3364.2
28	MISC. MANUFACTURED PRODUCTS	127.6	--	233.3	56.7	1050.2
29	RESIDENTIAL CONSTRUCTION	--	--	--	--	--
30	NON-RESIDENTIAL CONSTRUCTION	--	--	--	--	--
31	REPAIR CONSTRUCTION	31.1	--	--	--	2778.6
32	TRANSPORTATION & STORAGE	49.1	3936.6	--	715.2	7036.6
33	COMMUNICATION SERVICES	314.0	--	--	423.1	2537.0
34	OTHER UTILITIES	116.9	--	--	--	1663.8
35	WHOLESALE MARGINS	131.8	--	816.7	55.8	3699.0
36	RETAIL MARGINS	104.9	--	303.5	55.5	757.4
37	IMPUTED RENT OWNER OCPD. DWEL.	--	--	--	--	--
38	OTHER FINANCE,INS.,REAL ESTATE	890.0	--	--	--	6850.7
39	BUSINESS SERVICES	447.3	--	--	380.6	4195.2
40	PERSONAL & OTHER MISC. SERVICE	342.7	--	1264.5	814.2	3827.2
41	TRANSPORTATION MARGINS	46.7	--	142.6	16.2	1928.2
42	OPERATING,OFFICE,LAB & FOOD	731.3	--	--	--	5806.1
43	TRAVEL, ADVERTISING, PROMOTION	413.9	--	--	--	3403.0
44	NON-COMPETING IMPORTS	10.5	--	4.0	--	283.5
45	UNALLOCATED IMPORTS & EXPORTS	--	--	50.8	238.7	289.4
46	NET INDIRECT TAXES	279.9	--	569.8	245.4	7499.7
	GDP AT FACTOR COST	10459.8	--	--	--	87614.3
	TOTAL	**15901.1**	**3936.6**	**7207.4**	**4025.2**	**190668.5**

NOTE: DETAIL MAY NOT ADD DUE TO ROUNDING.

TABLE 07. FINAL DEMAND MATRIX (AGGREGATION - S), 1977 (MILLIONS OF 1971 DOLLARS)

NO.	COMMODITY AGGREGATION - S	CONS. EXP. DURABLE	CONS. EXP. SEMI DURABLE	CONS. EXP. NON DURABLE	CONS. EXP. SERVICES	CONS-TRUCTION, BUSINESS	CONS-TRUCTION, GOVERNMENT	MACHINERY, EQUIPMENT BUSINESS	MACHINERY, EQUIPMENT GOVERNMENT
1	GRAINS	..	..	..	..	..	..	..	..
2	OTHER AGRICULTURAL PRODUCTS	..	15.6	787.7	28.3	..	..	..	..
3	FORESTRY PRODUCTS	..	..	27.4	..	..	..	..	..
4	FISHING & TRAPPING PRODUCTS	..	..	14.2	..	..	..	..	..
5	METALLIC ORES & CONCENTRATES	..	..	..	..	..	..	..	..
6	MINERALS FUELS	..	..	52.7	5.5	..	..	..	..
7	NON-METALLIC MINERALS	..	2.0	11.6	..	..	..	..	..
8	SERVICES INCIDENTAL TO MINING	..	..	..	..	..	..	..	..
9	MEAT,FISH & DAIRY PRODUCTS	..	..	3324.4	..	..	..	..	..
10	FRUIT,VEG.,FEED,MISC.FOOD PROD	..	..	2551.6	..	..	..	..	..
11	BEVERAGES	..	..	1307.9	..	..	..	..	..
12	TOBACCO & TOBACCO PRODUCTS	..	..	467.5	..	..	..	..	..
13	RUBBER,LEATHER,PLASTIC FAB.PRO	200.1	613.1	47.1	..	..	..	13.6	3.4
14	TEXTILE PRODUCTS	283.9	390.2	55.9	7.3	..	..	11.1	1.3
15	KNITTED PRODUCTS & CLOTHING	..	2548.0	..	..	..	..	..	..
16	LUMBER,SAWMILL,OTHER WOOD PROD	23.3	66.8	1.2	..	..	..	14.6	0.3
17	FURNITURE & FIXTURES	719.6	27.7	..	..	..	..	172.9	50.1
18	PAPER & PAPER PRODUCTS	..	28.3	310.6	..	..	..	..	..
19	PRINTING & PUBLISHING	..	659.7	..	40.7	..	..	..	..
20	PRIMARY METAL PRODUCTS	..	1.0	..	..	..	..	-88.1	..
21	METAL FABRICATED PRODUCTS	60.4	220.3	10.7	..	..	..	221.9	25.2
22	MACHINERY & EQUIPMENT	75.4	32.6	..	..	..	..	3105.1	69.9
23	AUTOS,TRUCKS,OTHER TRANSP. EQP	3613.3	..	..	..	101.8	..	2109.1	243.3
24	ELEC. & COMMUNICATIONS PROD	1500.0	105.4	..	..	..	..	1703.5	47.6
25	NON-METALLIC MINERAL PRODUCTS	..	137.2	..	..	..	..	16.1	0.3
26	PETROLEUM & COAL PRODUCTS	..	0.5	894.6	20.1	..	..	..	..
27	CHEMICALS,CHEMICAL PROD	20.5	66.4	968.6	..	..	..	33.6	..
28	MISC. MANUFACTURED PRODUCTS	921.5	354.5	110.2	8.9	..	..	182.7	85.7
29	RESIDENTIAL CONSTRUCTION	..	..	..	..	5276.6	15.6	..	..
30	NON-RESIDENTIAL CONSTRUCTION	..	..	..	..	7608.6	3163.2	..	..
31	REPAIR CONSTRUCTION	..	..	..	36.5	..	..	..	..
32	TRANSPORTATION & STORAGE	..	..	95.4	1576.4	..	..	..	..
33	COMMUNICATION SERVICES	..	..	..	1663.8	..	..	..	..
34	OTHER UTILITIES	..	..	1427.0	302.6	..	..	..	..
35	WHOLESALE MARGINS	911.1	481.9	1268.3	12.4	10.9	..	1152.3	46.8
36	RETAIL MARGINS	2356.2	2589.5	3190.3	13.1	12.4	..	230.3	15.5
37	IMPUTED RENT OWNER OCPD. DWEL	..	..	..	7214.6	..	..	..	..
38	OTHER FINANCE,INS.,REAL ESTATE	..	..	..	7874.0	840.5	..	..	..
39	BUSINESS SERVICES	..	..	..	363.4	..	..	..	..
40	PERSONAL & OTHER MISC. SERVICE	935.4	67.0	..	8049.0	..	..	..	..
41	TRANSPORTATION MARGINS	135.0	160.6	340.6	3.8	2.1	..	168.5	10.5
42	OPERATING,OFFICE,LAB & FOOD	..	..	..	219.0	..	..	..	..
43	TRAVEL, ADVERTISING, PROMOTION	..	..	..	128.2	..	..	..	..
44	NON-COMPETING IMPORTS	..	..	112.9	..	..	..	..	..
45	UNALLOCATED IMPORTS & EXPORTS	..	..	..	1014.5	..	..	..	..
46	NET INDIRECT TAXES	1502.8	935.4	4083.2	409.3	7.9	..	868.9	41.9
47	LABOUR INCOME	..	..	..	2433.0	..	..	..	..
48	NET INCOME UNINC. BUSINESS	..	..	..	..	..	..	..	..
49	OTHER OPERATING SURPLUS	..	..	..	178.6	..	..	..	..
	TOTAL	13258.4	9503.7	21461.6	31603.0	13860.7	3178.8	9915.9	641.7

NOTE: DETAIL MAY NOT ADD DUE TO ROUNDING.

TABLE 07. FINAL DEMAND MATRIX (AGGREGATION - S), 1977 (MILLIONS OF 1971 DOLLARS) - CONCLUDED

NO.	COMMODITY AGGREGATION - S	INVEN-TORIES	DOMESTIC EXPORTS	RE-EXPORTS	IMPORTS	GOVT GROSS CURRENT EXPEND.	GOVT. SALE OF GOOD & SERVICES	FINAL EXPEND. ON GDP
1	GRAINS	49.2	909.3	0.2	-47.6	..	..	911.1
2	OTHER AGRICULTURAL PRODUCTS	-106.5	345.9	1.4	-443.5	20.4	-8.4	641.0
3	FORESTRY PRODUCTS	-25.9	34.5	0.1	-37.1	..	..	-1.0
4	FISHING & TRAPPING PRODUCTS	0.6	65.6	0.7	-79.1	..	-0.4	1.7
5	METALLIC ORES & CONCENTRATES	3.0	1164.5	0.3	-244.6	1.7	..	924.9
6	MINERALS FUELS	21.3	641.1	..	-905.3	14.7	-25.6	-195.6
7	NON-METALLIC MINERALS	3.4	281.2	3.4	-97.7	34.7	-0.2	238.4
8	SERVICES INCIDENTAL TO MINING	..	..	..	..	..	-0.3	-0.3
9	MEAT,FISH & DAIRY PRODUCTS	7.5	580.0	4.5	-371.1	0.1	-0.8	3544.5
10	FRUIT,VEG.,FEED,MISC.FOOD PROD	2.9	301.6	11.4	-618.7	..	..	2248.7
11	BEVERAGES	-17.9	265.9	0.2	-262.0	..	..	1294.1
12	TOBACCO & TOBACCO PRODUCTS	-35.2	40.7	0.3	-19.3	..	..	453.9
13	RUBBER,LEATHER,PLASTIC FAB.PRO	31.0	179.1	8.2	-838.5	0.4	..	257.4
14	TEXTILE PRODUCTS	-10.3	119.6	9.2	-928.9	23.9	..	-36.8
15	KNITTED PRODUCTS & CLOTHING	-146.4	69.3	4.3	-543.4	18.2	-2.3	1947.6
16	LUMBER,SAWMILL,OTHER WOOD PROD	-35.4	1377.7	2.1	-221.1	..	-15.6	1213.8
17	FURNITURE & FIXTURES	-9.6	53.5	1.4	-164.3	5.5	..	856.7
18	PAPER & PAPER PRODUCTS	-63.4	2234.0	2.7	-391.5	..	..	2120.7
19	PRINTING & PUBLISHING	12.2	62.8	7.8	-352.0	93.7	-18.2	506.6
20	PRIMARY METAL PRODUCTS	-30.4	2034.2	25.7	-754.1	..	-1.4	1186.9
21	METAL FABRICATED PRODUCTS	-97.0	393.1	20.1	-990.4	34.8	..	-100.9
22	MACHINERY & EQUIPMENT	-176.6	1161.0	153.5	-3531.1	29.2	-1.3	917.5
23	AUTOS,TRUCKS,OTHER TRANSP. EQP	154.5	7303.4	147.5	-8691.5	263.4	-1.7	5243.0
24	ELEC. & COMMUNICATIONS PROD	-62.4	537.5	49.8	-2301.7	58.3	..	1637.9
25	NON-METALLIC MINERAL PRODUCTS	-48.2	136.6	1.9	-397.6	..	..	-153.7
26	PETROLEUM & COAL PRODUCTS	158.2	191.8	2.4	-91.1	136.5	-1.1	1311.7
27	CHEMICALS,CHEMICAL PROD	0.5	741.0	24.5	-1391.3	220.4	-22.0	662.2
28	MISC. MANUFACTURED PRODUCTS	1.7	235.1	46.0	-1650.3	118.8	-23.0	391.7
29	RESIDENTIAL CONSTRUCTION	..	..	..	..	..	..	5292.2
30	NON-RESIDENTIAL CONSTRUCTION	..	..	..	..	50.0	..	10821.8
31	REPAIR CONSTRUCTION	..	..	..	..	612.5	..	649.1
32	TRANSPORTATION & STORAGE	..	785.3	..	-216.0	425.1	-67.1	2599.1
33	COMMUNICATION SERVICES	..	51.1	..	-72.3	317.1	-12.4	1947.4
34	OTHER UTILITIES	..	240.0	..	-8.7	333.1	-237.4	2056.6
35	WHOLESALE MARGINS	..	888.5	0.6	-153.2	95.1	-5.7	4709.0
36	RETAIL MARGINS	..	..	..	..	56.9	..	8464.2
37	IMPUTED RENT OWNER OCPD. DWEL	..	..	..	..	..	..	7214.6
38	OTHER FINANCE,INS.,REAL ESTATE	..	113.5	..	-507.4	559.3	-333.5	8546.2
39	BUSINESS SERVICES	..	239.1	..	-689.5	1205.4	-117.7	1000.8
40	PERSONAL & OTHER MISC. SERVICE	..	22.6	..	-26.5	2342.5	-1059.6	10330.3
41	TRANSPORTATION MARGINS	..	1141.9	7.1	..	38.2	..	2008.4
42	OPERATING,OFFICE,LAB & FOOD	..	..	..	..	1182.3	..	1401.3
43	TRAVEL, ADVERTISING, PROMOTION	..	..	..	..	493.9	..	622.2
44	NON-COMPETING IMPORTS	2.2	..	..	-398.6	..	..	-283.5
45	UNALLOCATED IMPORTS & EXPORTS	..	1968.0	4.9	-3276.8	..	..	-289.4
46	NET INDIRECT TAXES	..	3.5	..	1626.1	119.9	..	9599.0
47	LABOUR INCOME	..	..	..	..	14221.6	..	16654.6
48	NET INCOME UNINC. BUSINESS	..	..	..	..	..	..	..
49	OTHER OPERATING SURPLUS	..	..	..	..	1828.9	..	2007.5
	TOTAL	-417.1	26913.5	542.1	-30068.0	24956.7	-1955.9	123375.0

NOTE: DETAIL MAY NOT ADD DUE TO ROUNDING.

PROBLEMS IN THE COMPILATION OF INPUT-OUTPUT TABLES IN THE NETHERLANDS

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1. INTRODUCTION AND SUMMARY

This paper deals with problems concerning the compilation of input-output tables on which we are working at present in the Netherlands. It emphasizes organisational problems, which arise on the one hand from the increasing demands made on the tables, and on the other hand from the development of the compilation facilities. In this connection may be mentioned the development of basic statistics, man power and computer facilities. This paper deals mainly with "problems" and with indications of the solutions, on which work is progressing; at the present stage it is not yet possible to report on finalized solutions. In a few year's time some more detailed papers on specific questions may be expected. It will then also be possible to pay attention to the experience gained up to the stage of what may then be seen as the final solution.

The central problem may be summarized in the following questions. How do we compile input-output tables which are detailed, of recent date and fully consistent with similar tables of preceding years, and that are accurate as well. Accurate in this connection means: as much as possible in accordance with <u>all</u> information available for the reporting year. How can these demands made on input-output tables, which are to some extent conflicting, be reconciled? What are the priorities? How should the compilation process of such tables be organized?

Chapter 2 of this paper gives a brief history of input-output tables in the Netherlands.

Chapter 3 sketches how until recently the compilation of input-output tables was organised and to which limitations it led in practice.

Chapter 4 deals with some "external developments". The points at stake here are in particular the users' preferences and the available basic statistics.

Chapter 5 is concerned with the problems of quality improvement of the results in relation to the demand of consistency over time. The central question is here:

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what has priority in the compilation of annual input-output tables, the comparability (in detail) with tables of previous years or merely the level of the actual estimate for the reporting year by itself?
Capter 6 deals with the general criteria used in the design of the computerized system which is being developed and which will play an essential role in the solution of the problems described.

2. THIRTY YEARS OF INPUT-OUTPUT TABLES.

Input-output tables were initially developed in the Netherlands as an aid in the compilation of the national accounts. Already during the Second World War experiments were carried out. The tables were seen as an important aid for obtaining consistent estimates of supply and demand of goods and services. Quite soon it was realised that input-output tables could also be used as instrument of analysis, e.g. for planning and extrapolation and for determining the accumulated cost coëfficients. This development took place in the Netherlands during the fifties. While this went on, the need for complete input-output tables at constant prices manifested itself. Untill now, however, tables at constant prices have not been drawn up yet. The main problems were : incomplete price statistics and lack of resources. As regards the latter it should be stated that a manually compiled table at constant prices is very labour intensive. Tables of this kind are now being developed. The Netherlands do, however, have a nearly complete series of annual input-output tables at current prices from 1948 onward, in which approx. 35 branches of industry are distinguished. These are tables drawn up annually from a large quantity of detailed basic data; they are therefore not products of interpolations made with the aid of RAS methods or similar devices.
The existence of these tables had a stimulating effect on the use of such detailed data as time series. This sometimes caused problems. The balancing of the tables, the rectification of earlier mistakes and the application of new basic data sometimes led to inadequate comparability over time of the detailed information. When the Central Bureau of Statistics (C.B.S.) instituted a new standard industrial classification of all economic activities in 1969, it became clear to what extent the use in the form of time series had become preponderant. Even at present the C.B.S. is under pressure from users to restore the consistency of these time series before and after 1969 ; unfortunately the resources to achieve this are lacking. The compilation method of the input-output tables has hardly changed in the past thirty years, nor have any major changes been introduced in the organisation of the compilation process. At present, however, drastic changes are to be expected in the short run. Before considering their background and content the outline of the traditional procedure will be sketched.

3. THE ORGANISATION OF THE COMPILATION OF INPUT-OUTPUT TABLES

Input-output tables in the Netherlands are compiled by the National Accounts Department of the C.B.S. The collection of statistics in the Netherlands is highly centralised. For this reason the main statistical sources of the input-output tables are compiled and elaborated annually or more frequently by the C.B.S..
These are, among others :

-detailed production statistics, including cost structure surveys;
-foreign trade statistics;
-labour and wage statistics.

In addition there is a very large number of specific statistics, which are used as source for input-output tables, and which are prepared outside the C.B.S. An exhaustive enumeration of all these statistics is not feasible in the context of this paper.
The delimitation of responsibilities between the National Accounts Department and the other Departments of the C.B.S. used to be (and still is) as follows. The basic statistics are compiled by specialized Departments of the C.B.S. and not by the National Accounts Department. They are usually collected through surveys which cover selected branches of industry or part-sectors and which are often of the "cut off" type i.e., the smallest firms are excluded. One of the responsibilities of the National Accounts Department is the preparation of estimates for the many non-observed branches of industry and sectors and the preparation of additional estimates for partly observed branches of industry.
In addition the Department is responsible for estimating all relevant data which do not appear at all in the available statistics or only with insufficient specifications. It is also responsible for the integration process of all data. In essence this is the basic responsibility, though the first mentioned elements of responsibility take up a much more important part of the resources. As a result of this integration process input-output tables and other national acoounts data are fully consistent.
In recent times the distribution of responsibilities between the National Accounts Department and the other Departments of the C.B.S. is beginning to undergo a change. The latter Departments are gradually taking over the responsibility to cover the field completely and for supplementing the "cut off" statistics with sample data regarding groups which because of their (lack of) size have not been included. In addition, improved statistical coordination relating to statistical units, their subdivisions, classifications, nomenclatures and definitions is under discussion.
In this respect the needs of the integration process are increasingly taken into account. It is, however, a very gradual process, so that for the practice of the compilation of the input-output tables the above indicated division of responsibility is still relevant.
The responsibilities of the National Accounts Department have in broad lines been

divided as follows. On the one hand there are "specialists" engaged in the preparation of estimates for a limited number of branches of industry or sectors. On the other hand there are "integrators" who take care of the consistency of the input-output tables as a whole. So far the responsibilities of the specialists have included, among others :

1. the estimation of the level and composition of output and input;
2. The determination of the global sales distribution of the output with special reference to exports and to the destination of specific products (products with a limited number of destinations) in consultation with the specialist of the consuming branch of industry or sector;
3. the determination of the global origin (branch of industry or foreign countries) of the input with special reference to the origin of specific products in consultation with the specialist of the supplying branch of industry or sector.

The specialists' calculations were carried out in great detail (some thousands of commodity groups and many hundreds of industry groups). Its final result has not, however, resulted in a fully balanced table, as the balancing has been restricted to specific supplies. This final result forms the point of departure for the integrators. They complete the balancing process, if necessary in consultation with the specialists. They do this, however, at a highly aggregated level (appr. 60 branches of industry) without using any systematic distinction between the various kinds of commodities.

It will be clear that so far only the broad lines of the estimating process have been described. Other aspects of the distribution of responsibilities, such as coordination, planning and shaping of activities are not under discussion.

For the activities as a whole there is question of an extremely limited degree of computerization. The task of the specialists is therefore very labour intensive. Each input-output table compiled at the National Accounts Department takes up appr. 18 man-years. Another consequence of the mainly manual compilation process is the high level of aggregation of the final balancing. All this is not without consequences for the flexibility of the estimating process and for the quality of the results. The most important consequences are :

1. only one fairly small (aggregated) table becomes available;
2. the work is divided in phases with little flexibility;
   the order of work has in some cases a significant impact on the results achieved;
3. the possibilities of repeating previously performed activities on the basis of views in later phases are limited;
4. the final balancing cannot possibly take complete account of all available detailed information.

Additional consequences are :

5. in practice it is almost impossible to achieve that similar operations are carried out in the same manner by different specialists;
6. given the previous limitations it is difficult to arrive at reliable descriptions of methods;
7. it is extremely labour intensive to prepare alternative specifications of input-output tables retrospectively.

Recently, in anticipation of future computerization, some adjustments of the methods have been introduced. In practice, however, the restrictions mentioned have remained in effect.

4. RECENT "EXTERNAL DEVELOPMENTS"

The "external developments" which are the subject of this chapter, are concerned with developments within the sphere of users of input-output tables (4.1. and 4.2.) and developments regarding the basic statistics (4.3). These are "external" in the sense that they take place outside the National Accounts Department which compiles the tables. The developments described in 4.1. and 4.2. reflect general trends inside and outside the sphere of economic policy, among others in scientific research uses of input-output data .

4.1. Selective growth policy

Some five years ago a government policy memorandum appeared which had two titles: (1) Economic Structure Memorandum and (2) Memorandum concerning Selective Growth. The first title relates to the "continuity" element of policy formulation. This is considered in greater detail in paragraph 4.2. The second title relates to the "selectivity" which was added to the traditional growth objective. Economic growth had to be selective in the sense that weight had to be given to a number of so-called "aspects" of economic growth: (1) environmental pollution; (2) energy and raw materials shortage; (3) town and country planning and (4) division of labour in respect of developing countries. This extension of the objectives of economic policy was not unexpected. A variety of discussions particularly stimulated by research groups such as the Club of Rome, had preceded them. In support of these policy objectives the C.B.S. National Accounts Department carried out input-output studies that focussed on the use of energy and on environmental pollution.

The aim of these studies was to compile a so-called "aspects matrix". This aspects matrix would include accumulated coefficients calculated per commodity group – with the aid of input-output analysis – with regard to different types of environmental pollution, kinds of energy and raw materials consumption. It would also include accumulated coefficients of employment (specified according to professional group, level of education, etc.), types of income and net foreign trade.

Within the framework of the selective growth policy these studies are considered to be of great importance. The statistical implications are twofold:

- on the various aspects the necessary information will have to be collected in such a manner that it can be linked to the input-output table detail; this requires a good deal of statistical coordination;
- the input-output tables may have to be amplified in detail; the policy makers generally hold the view that tables with 50 to 60 commodity groups for which up till now a concise aspects matrix could be published, are too aggregated and that

a disaggregation to appr. 250 groups is required.
It is also considered to be of great importance that possibilities are created for analysing intertemporal developments of the accumulated coefficients as a consequence of changes in (1) the pattern of expenditure, (2) structure of production (direct input coefficients of intermediate consumption) and (3) direct aspect coefficients. Thus the question can be answered to what extent the aspect intensity (e.g. energy intensity) of national expenditures has been altered as a result of developments in the pattern of expenditure, the structure of production or the aspect intensity (energy intensity) of the individual production processes.
The demands made on statistics will therefore have to be supplemented by the requirement of consistency in time of both the input-output tables and the data on aspects.

4.2. Structural policy

The "continuity" element which was the other main theme of the Economic Structure Memorandum mentioned in the previous paragraph relates to the objective of full employment. New ideas on economic policy with regard to individual sectors and directed at the strengthening and renewal of the economic structure were being developed. An important instrument was the stimulation of investments through premiums, directed among others at the strengthening of the competitive position vis-a-vis the rest of the world. This policy has afterwards been elaborated in greater detail in other government policy memoranda.[1)]
This development has resulted in a very large demand for statistical data because "sector" in sector policy has the same meaning as "industry group" in the Standard Industrial Classification of the C.B.S. (3rd digit level).[2)]
For each of these sectors there is a need for a large quantity of statistical information to be made available in such a form that it can be interlinked. In other words, the data have to be coordinated and to a large extent made available in integrated form. One clear requirement with respect to the input-output tables was explicitly formulated: they should be specified in great detail (at least at "sector" level); they should become available annually; they should be timely (the present period needed for compilation - publication 2½ years after the reporting year - was considered much too long). Furthermore there was the need to use detailed data of the input-output tables in the form of time series.

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1) Among others in the Progress Memorandum Economic Structure Policy (sector memorandum), 1979
2) This level of aggregation is considerably more disaggregated than the level of aggregation of the "Major group" of the ISIC (3rd digit).

4.3. Basic statistics

Apart from the "external development" within the sphere of the use made of input-output tables, there are also important developments within the sphere of the basic statistics from which the tables are compiled.
It goes without saying that alterations in (the availability of) basic statistics have consequences for the comparability of input-output tables over time. Alterations of this kind have occurred to a large extent in the Netherlands during the seventies. The C.B.S. has been able to establish a number of important new statistics covering fields where in the past very rough estimates had to be made. It appears that these rough estimates have not always been perfect so that there is cause for considerable adjustments in the level of a number of estimates. Additionally, as part of the C.B.S.'s statistical coordination programme, industrial classifications have been adjusted in many statistics.
This sometimes led to the elimination of gaps in the existing statistical observations, resulting in considerable alterations in the basic data. Also in the more distant past the annual production statistics provided no accurate time series. In the first place because the informants are always approached in accordance with the actual circumstances so that in the event of a change in the main activity the informant receives a different questionnaire. Secondly because those compiling the basic statistics at the C.B.S. were (and still are) only seldom inclined to compile supplementary estimates in addition to the data based on inquiries. In the third place - and this is an additional consequence - the demand of users in the past 30 years could concentrate on the more consistent series from the national accounts.
It is to be expected that newly available statistics which are either drastically changed or entirely new will be - in the near future - the main reason for revisions of the input-output tables.
Other reasons may be the improvement of estimating methods and changes in classifications and methods of registration.
The latter two reasons are not causing the most difficult problems. Particularly in the case of changes in classifications etc., it is fairly easy to apply corrections for a number of years so that comparability in time may be restored.
In the meantime it cannot be denied, that such corrections, particularly in the case of manual operation, may lead to organisational problems. Restoration of continuity of the time series after a revision of the input-output table might become particularly difficult when entirely new information becomes available which leads to estimates which are considerably different from those made in the past. Indeed, newly obtained information does not throw fresh light on the more distant past. The basic question here is: were the old estimates mistaken because they were always made at an incorrect level or because, possibly from a correct level, an incorrect development was estimated. As long as this question has not been answered, it is doubtful

whether it is meaningful to estimate a new time series. What matters is the objective of the revised estimate. If it is a question of providing information on an unimportant element of a larger entity, e.g. a higher aggregate, the answer to the question posed is less relevant. However, if it is a matter of estimating detailed series, the answer is of vital importance.

4.4. Conclusions

The developments in the use made of input-output tables point to a strong need for timely tables which are considerably more detailed, the details having to be reliable and comparable over time.
The developments in the basic statistics for the tables enable significant improvements in the reliability of the data to be carried out but the comparability over time will be harmed as a result.
The type of solutions that are sought with respect to the improvement in quality and the implied interruption of the continuity as a result will be dealt with in the next chapter.
Chapter 6 will then be concerned with the combination of these problems with the requirement of timeliness and the disaggregation of the input-output tables.

5. REVISIONS AND TIME SERIES

This chapter gives a rough sketch of the manner in which the problem of quality improvement and hence interruption of the continuity of the input-output data is being handled.
The following subjects will be discussed subsequently: the priority assignment (paragraph 5.1.) some of the technical aspects (paragraph 5.2.) and the organisational implications (paragraph 5.3.).

5.1. The dilemma

The central question is: what deserves priority in the compilation of annual input-output tables: the comparability (in detail) over time with tables of previous years or the accuracy of the estimates for each reporting year.
At first sight there is the problem that accuracy of the level of the estimates per reporting year leads to discontinuity in the time series. This discontinuity cannot be immediately restored.
The theoretical ideal of unsurpassable quality of estimates has not been achieved; nor is the theoretical "next best" solution practicable whereby all discontinuities arising from annually accurate level estimates are restored immediately in a consistent manner in the details of a long series of annual input-output tables.
The allocation of priorities is therefore inescapable in the Dutch situation, where two circumstances are of particular significance. The first one is that the compilation of input-output tables forms part of the estimation process of national accounts. The tables are always fully consistent with the national accounts.
Therefore assignment of priorities with regard to input-output tables cannot be dissociated from the allocation of priorities in the national accounts.
Furthermore the frequent use of input-output tables in the form of time series, together with the increasing tendency to further disaggregation of the tables implies that discontinuities which may be small in absolute value will lead to greater relative distortions of time series. Priority has therefore been given to comparability with tables of preceding years. The resulting concessions which have to be made to the accuracy of the annual level estimates can, needless to say, only be of a temporary nature.
Complementary to this allocation of priority is that periodical (probably once every five years) corrections of the level need to be implemented. These revisions lead to accurate level estimates for the reporting year for which the revision is implemented, and have to be followed by new estimates of input-output series which are consistent over time. In this manner the burden of the reassessment of a series of tables is reduced from once annually to once every five years without making concessions to

continuity. However, even this procedure implies such a burden that all this cannot be fully realized in the short run. Before dealing with the organisational aspects some light will first have to be cast on the statistical aspects of continuity.

5.2. What is continuity?

Continuity as quality of a time series can be described as perfect comparability of the estimates for period t with those for t-1. The change over time (t, t-1) is then an accurate estimate of the development which has taken place in reality.
A practical elaboration of this description is, however, not without complications. Annex 1 gives explanatory notes to some problems which will be touched upon in this paragraph.
Basically the following questions arise:

1. With reference to the changes (t, t-1), should the absolute or the relative size (in regard to the estimated value in period t-1) be estimated accurately?
2. What is an accurate estimate of an element of an aggregate? At which level of aggregation should the estimate be accurate?
3. What should be understood by an accurately estimated relative change within an integrated framework? In other words: should the accuracy of the estimate of the change in one of the elements of the table be considered by itself, in relation to the other variables on the same row or in relation to the other variables in the same column? Are there rows and colomns which in the eventual search for a "compromise" deserve priority?

The answer to the first question seems simple. If it is a matter of time series, priority will have to be given to the relative change. However, it will be understood immediately that this will give rise to problems. As it is, a matrix of perfectly estimated absolute changes just "fits the bill" but a matrix of perfectly estimated relative changes based on an imperfect table for the previous period, is in principle inconsistent. Nevertheless it seems that the answer given in the first place will have to be maintained.
This being said, the other questions also need to be answered.
Question two is concerned with the problem that perfectly estimated relative changes of elements do not necessarily add up to a perfect estimate of an aggregate's relative change.
If the errors in the levels of the estimated elements do not correlate with the size of the relative changes, no serious problems need to be expected with regard to aggregation. If the number of elements aggregated is not too small, the relative change of the aggregate will show no "bias". This may be of some comfort to statisticians compiling input-output tables as an intermediate step to estimating the

national accounts.
In the case of aggregation of a small number of elements, however, such comfort is hardly justified. Users of input-output series should be aware of this.
So far the argument has been "ex ante": the point of departure consisted of accurately estimated relative changes of elements which were then weighted with inaccurately estimated level data to arrive at a relative change of an aggregate. From the user's point of view the matter can also be considered "ex post". In that respect it may be asked to what extent erroneous estimates of the relative changes of elements give rise to erroneous estimates in the aggregate's relative change. The question is then whether in the elements of input-output tables erroneous estimates in the levels are in fact uncorrelated with relative mutations. Particularly if the tables are estimated in such a manner that they are comparable as well as possible over time, it is probable that underestimates are also the result of changes which were estimated too low.
With respect to question two the conclusion must be in principle that the choice of any aggregation level for estimating relative mutations distorts the mutations at any other level. This leads particularly to consequences for data at aggregation levels containing a small number of elements for which correct relative mutations were estimated.
There is, however, not much reason to assume that distortions would not arise at the higher aggregation levels.
Finally the third question. In an input-output table aggregation should hold along the rows as well as along the columns. This implies that the estimation of an individual element has in principle an impact on all other elements. Accurate estimation of the relative change of an intermediate transaction flow between an underestimated and an overestimated branch of industry will usually result in distortions of the relative change of other elements on the rows and columns of the two branches of industry concerned (see Annex 1).
Given the above mentioned consequences the selection of the estimation method is of particular importance. For those elements of the table for which more or less reliable estimates can be made of their level and relative change over time before integration, there is no need to fear large distortions of relative changes of the main aggregates constructed from these elements. However if important vectors - such as operating surplus, private final consumption, change in stocks - are estimated as residuals, special care is required. The estimated changes of such vectors should always be checked carefully and in detail in order to judge their plausibility. Though this plausibility check should always be made with regard to the level of the residually estimated items in an input-output table it deserves special attention, when one tries to arrive at correct relative changes as is illustrated in Annex 1. The conclusion of this paragraph must therefore be that making accurate estimates of the relative mutations of all elements of an input-output table is impossible, unless

the table serving as point of departure is perfect.
For obvious reasons, most statisticians have never felt uncomfortable with this kind of conclusion. It remains, however, of interest to users of statistics that the objective of comparability over time of input-output tables is pursued as well as possible. Furthermore it is of equal interest to users of statistics to be aware of the defects in their data.

5.3. Organisational aspects

In this paragraph the following subjects will be discussed subsequently:

- how continuity in the Dutch input-output tables is being pursued (5.3.1.);
- how periodical revisions with restoration of continuity will be achieved (5.3.2.);
- what action should be taken in the short run? (5.3.3.).

5.3.1. Continuity in practice

In the compilation of input-output tables the emphasis has, as stated above, in recent years been put on maintaining comparability over time. As is illustrated in Annex 1, this is no simple matter.
As a consequence of what was stated in chapter 3 with regard to the organisation of the compilation of the Dutch input-output tables, the following objective has been pursued.
The specialists aim at accurate estimates of relative mutations at the level of aggregation to which their most detailed estimates relate (see chapter 3). As regards their responsibility mentioned in chapter 3 under 1, this is, given the aggregation level, a clear criterion. As regards responsibilities 2 and 3, the third question of paragraph 5.2. becomes relevant. The specialists generally arrive by common agreement at the most plausible "compromises". However, as their field of observation is restricted, at the stage of integration they usually arrive at "compromises" which still include many "residual items" particularly in the rows of the tables. The integrators deal with the data at a more aggregate level. In their interventions they are led - in addition to the advice given by the specialists - by the pursuit of accurate estimates of relative mutations at their level of aggregation.
The achievement of practical solutions to the above mentioned continuity problem is based partly on plausibility judgments of the "residual items". A maximum number of alternative estimates based on other sources are compared with these residual items. The conclusion appears to be that the aggregation level at which continuity is defined can not be fixed unambiguously, but is determined by reasons of an organisa-

tional nature. If total integration could be carried out at the most detailed level of aggregation, a more consistent procedure would be possible.
Chapter 6 indicates how this situation can be achieved.

5.3.2. Revision plus continuity requires computerization

Implementation of complete integration in an input-output table up to the detailed level of thousands of commodity groups and hundreds of industry groups is impossible within the present organisation. It requires computerization of the estimating (and particularly of the integration) process.[1)]
There is, however, another reason for introducing computerization which is at least as important. If we wish to carry out periodical revisions and have them followed by new, consistent series of input-output tables, a large number of input-output tables will have to be compiled within a relatively short period. In the event of a revision occuring once every five years and a time series of ten years, at least 15 tables will have to be made every 5 years. A ten year time series even seems a modest objective from the point of view of the users of statistics in the Netherlands. In the existing organisation even the annual compilation of one input-output table is not without problems. It is therefore obvious that the problems discussed in this chapter can find no satisfactory solution without far-reaching computerization.

5.3.3. The short-term solution

Under the limitations described above which are imposed by the present organisation a difficult choice had to be made. This choice resulted from the fact that on the one hand the computerization facilities required were not yet available while on the other hand a large need had been created for the short-term implementation of a first revision.
In consultation, among others, with the most important users of input-output tables it was decided to carry out a short-term revision, even if not immediately followed by newly established time series.
The need for this revision was felt because some significant estimation errors were found in a number of branches of industry (see paragraph 4.3.).

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1) In theory annually so detailed input-output tables could be compiled manually. However, one should not have any illusions on the consistency of the decision making process, nor on the organisational efficiency in the integration process. The relations between the input-output elements are too complicated to be checked manually in such a manner that acceptable solutions can still be expected. The quantity of information to be processed is too large for this.

In addition, there was the wish of the Department of National Accounts not to wait any longer with a first revision. The "extrapolation" of incorrect level estimates was found unsatisfactory, while furthermore uncertainty existed regarding the time at which the computerization facilities required for the restoration of continuity would become operational. It was therefore decided to carry out a first revision which would be restricted in scope. This will include for the reporting year 1977:

- an alternative complete series of national accounts data, so that for 1977 a "revised" estimate will become available, which will be published jointly with the "old" 1977 estimate;
- a revised input-output table linked to the revised national accounts series which would be presented jointly with the previous unrevised table so that comparison with tables of preceding years is feasible.

The year 1977 functions as a link up year for the time being: up to and including 1977 there is a consistent series of input-output tables and from 1977 onward there will be a new series which will also be consistent.

6. COMPUTERIZATION

As early as some eight years ago concrete ideas were developed regarding the computerization of the compilation of input-output tables. From the outset it was clear that this would be a complicated and vast project, the more so since computerization was not to result in loss of quality. It was essential that the various separately developed subsystems could be interlinked afterwards.
That is why the computerization of the input-output table compilation was tackled in an integrated manner. The present chapter describes in broad lines the system which is to be computerized.
In paragraph 6.1. the objectives are recapitulated. Paragraph 6.2. contains a brief summary of the description of the system which is given in more detailed form in Annex 2. Paragraph 6.3. deals with the principal limitations and with some particular features offered by the system, to be followed by some final remarks in paragraph 6.4.

6.1. Objectives

At the end of chapter 3, seven implications of the manually operated compilation of input-output tables were mentioned which in actual fact contain as many limitations of the possibilities.
In chapter 4 it was concluded that there is a strongly increased need for timely, considerably disaggregated tables which are furthermore comparable over time. A number of the restrictions mentioned in chapter 3 has therefore turned into serious limitations.
One of the conclusions of chapter 5 was that in order to actieve a satisfactory solution to the problem of revisions and restoration of continuity, computerization was indispensable. The same applies to the removal of the restrictions of chapter 3. Summing up, computerization of the compilation of the input-output tables has the following objectives:

1. Timeliness

   On the one hand computerization can shorten the compilation process of the tables. On the other hand it is possible, even at an early stage and proceeding from incomplete or very provisional basic material, to make a first version of an input-output table which in its detailed layout corresponds with the final version which is to be compiled later. If the manual compilation is continued this procedure is not feasible due to limitid resources. Within this framework attention is also paid to the connection with computerization processes for basic statistics.

2. Improvement of quality

A number of aspects play a role in this context. As a result of further disaggregation throughout the compilation process, made possible by computerization, greater consideration can be given to all available (detailed) information when judging the plausibility of the final results.
The possibility to effect the integration in an iterative process facilitates the reconsideration of decisions which had to be taken at earlier stages if afterwards they turn out to have unacceptable implications. The computerization of the administrative process concerned with integration enabers the decentralisation of integration to take place. More people, among whom the specialists, can express their opinion on the computer results. This leads to justice being done up to the final stage, to the specialists' expertise.

3. Continuity

The formalisation of the estimation processes by which computerization is necessarily accompanied makes it possible to gain a clearer view of the methods practised. This implies that maintenance of the estimates' continuity can be more easily achieved than with manual compilations by a large number of specialists. Paragraph 6.3. sketches briefly how continuity has been built into the system. When the continuity is interrupted as a result of revisions, the less time consuming character of the computerized compilation of input-output tables makes it possible to restore continuity by the compilation of a new series of tables. This may be done by calculating backwards in time on the basis of that part of the basic material which had already been used before, when the tables for the years concerned were compiled. Only the revised data must be introduced in the required form into the computer.

4. Detailed treatment and flexibility

After computerization the input-output table becomes available in considerably disaggregated form (approx. 1.000 commodity groups, approx. 200 industry groups; the dimensions will be gradually further enlarged).
This does not only create the possibility to publish detailed tables, it also increases the flexibility in various respects. It is thus possible to compile tables with alternative classifications. A detailed table of this kind is also an excellent starting point for compiling input-output tables at constant prices. Apart from the detailed treatment computerization provides increased flexibility in other respects. Tables with alternative valuations can be easily printed out.
It is possible to experiment with alternative estimating assumption (distribution keys in the absence of direct information). The design of the balancing process enables a first step to be taken in the direction of real estimates of the accuracy of the results.

6.2. Outline of the system

The system for the computerized compilation of input-output tables which is now being developed, includes in principle all operations on the basic statistics including the final stage of the elaboration of the complete table. It is a very elaborate and complicated system of which interesting details will have to remain practically undiscussed in this paper.
Annex 2 gives a rough schematic outline of the system and includes examples. In this annex some aspects are elaborated in somewhat greater detail. This paragraph may therefore be limited to a summary discussion. The system is in principle divided into two parts:

- operations per column;
- the actual integration.

The first part concerns the operations required to arrive at a first estimate of all elements of the input-output table, starting from the basic data. The operations are carried out per "column", including the column of the row totals of the input-output table (the total supply from production and imports per row). These operations include estimates of data that are not available in the basic statistics and the adaptation of the basic data to the specifications of the input-output table[1].
The second part includes the entire integration process. The distinction between the operations per column and the actual integration in the computerized compilation is different from the existing one in the manual compilation between the tasks of "specialists" and "integrators" as described in chapter 3.
Traditionally the specialists carried out a number of integrating operations for some transactions while on the other hand not specifying all input to the extent required to place them immediately on the rows of the table. The integrators then completed the integration process requiring them to work with rough distribution methods, as far as the incompletely specified inputs were concerned.
In the first part of the new system - the operations per column - the elements of the input-output table are built up, on the one hand from the available basic data and on the other hand from some elements originating, possibly but not necessarily after mutation, from operations completed for the preceding reporting year. The available basic data from production and foreign trade statistics are after plausibility checks inmmediately introduced into the system. Specific basic statistics are manually prepared for the computer.

1) Chapter 3 on the distribution of responsibilities between the National Accounts Department and the collecting departments of the C.B.S.

The integration process should lead to a balanced table. This means that the elements (estimated for each column) of the internal part of the table add up to the independently estimated line totals. There are not necessarily residually estimated items such as changes in stocks which would automatically balance the table; the system does provide for that possibility, but it is not a rule. The change in stocks is in general estimated in the first part of the system on basis of direct observations.
The integration process refers particularly to the intermediate and final demand broken down in commodity groups. These commodity groups are again subdivided in rows (cf. annex 2), but this will be left undiscussed in this chapter. There are also some special commodity groups the discussion of which falls outside the scope of this chapter. In principle three categories of commodity groups may be distinguished.
The first category includes those commodity groups whose elements were estimated in the first part of the system; these elements are corrected in the integration process, bearing in mind the accuracy of the estimate , so that they would add up to the row total.
The correction of the elements is accompanied by a compensating adjustment of other elements of the "non factor inputs" (belonging to the first two categories of commodity groups) in the same column. The second category consists of commodity groups of which an element is estimated as residual item. In this group the integration process consists particularly of the compensating corrections that are made in the course of the integration procedure of the first category of commodity groups. The residual items are generally private final consumption and fixed capital formation, though the computerized system - and also the working programme - does provide for the possibility of independent estimates of these items. This category will therefore largely disappear. The third category includes commodity groups whose elements are estimated autonomously, as in the first category of commodity groups but whose compensating corrections are applied to the operating surplus in the same column.
The difference in procedure between the first and the third category is related to the nature of the basic data. The first category includes commodity groups that are specific inputs into production processes and which as a rule are explicitly covered in productions surveys of the main users. The third category is concerned with the general input ("other costs") that are not specifically identified in the production surveys. The particular treatment of this category of commodities is based on the assumption that the production surveys generally include the exploitation surplus of the business accounts and that other costs are estimated as a residual item. Since the definition of operating surplus clearly differs from the business-accounting definition of exploitation surplus, there is no reason for keeping the operating surplus outside the integration process. For all three categories of commodity groups the row totals will for the time being be regarded as final. In other words: total imports and total domestic production per commodity group will remain unchanged in

the integration process.
The system does permit, however, to change also the row totals in the integration process. Once practical experience has been gained with the system, these facilities will no doubt be experimented with. For a description of these more "sophisticated" balancing methods the reader is referred to Annex 2, point 2.6.4.

6.3. What is and what is not possible under the system

This paragraph discusses the manner in which the system may in our view be applied. The main application concerns the annual compilation of a detailed input-output table (6.3.1.). The system also seems practicable for the compilation of alternative tables and provisional tables for very recent periods and for drawing up time series and tables after revisions (6.3.2.). The system is typically aimed at continuity (6.3.3.) and may be of use for the purpose of ascertaining the accuracy of input-output tables (6.3.4.).

6.3.1. The annual input-output table

The system has been designed in the first place for the compilation of the annual input-output tables. It includes in principle all operations between basic data and the fully integrated table. This does not mean, however, that it is left to the computerized compilation system only to arrive at the best table possible from a given set of basic data. The system may be regarded as a complete computerization of the administrative aspects of the compilation which furthermore includes some simple formal statements regarding the statistician's decision making process, particularly within the framework of the integration process. It would however be illusory to believe that a system could be developed embracing the statisticain's complete decision making process that would result in empirically justified input-output tables.
In a number of phases of the operations statistician's will carry out extensive plausibility checks, in addition to checks on the introduction of the data and on the operation of the system.
From the outset the basic data will have to be checked on "continuity". Are they comparable with corresponding figures of the preceding year? Are the data for each industry group mutually consistent?
Next the estimates per column will have to be checked on plausibility and continuity. After completion of these checks on the columns of all industry groups, the question will be asked for each commodity group, whether the system's integration method can be applied or whether it will first be necessary to intervene manually
This last question could, of course, be asked later, after the system had completed

the balancing. This procedure, however, would result in higher computer cost and has furthermore some organisational disadvantages. The danger of such a complicated computerized integration procedure is that the statistician loses sight of the problems in detail, particularly since the product has to be an input-output table that is detailed, and satisfies the continuity conditions. It seems therefore more appropriate to include checks by the statistical specialist before rather than after the integration process. The solution by computer should be regarded as the least creative.
In addition plausibility checks will be applied in different stages after the balancing covering all available statistical detail.
When doing this the opportunity exists to analyse with the aid of the computer, why a specific adjustment to a variable had to be made by the computer during the balancing process.
The plausibility checks will have to be carried out by "integrators" as well as by specialists. As specialists are also involved in parts of the integration process they share the responsibility for the final result.
Contrary to what is possible in the manual compilation, specialist knowledge and all available detailed information can be fully taken into account in the final result of the computerized compilation. Particularly the use of iterative methods makes it possible to modify previously made decisions that led to less plausible results in a later phase.

6.3.2. Other input-output tables

As a result of the detail in which the tables were compiled they offer a good point of departure for the application of alternative specifications (industries, commodities). Also the compilation of tables at constant prices will be considerably simplified from the organizational point of view. For the compilation of the annual input-output table the system will make use of a very large quantity and variety of basic statistics. It will, however, also function if limited information is available on e.g. the wage total for the entire industry group and the production value and wage total for the observed part of the industry group, such as for the larger enterprises. Thus it is possible to use the system for drawing up very provisional estimates for recent periods. Finally the system is also intended for the estimation of time series after revisions. As such revisions require considerably less plausibility checks per reporting year than when normal annual tables are compiled, the time saved by the system will be relatively much more for revised than for regular input-output tables.

6.3.3. Continuity

In the course of operating the system particular attention will be paid to continuity. This will naturally be the case first of all within the framework of the plausibility checks, starting from the assessment of the basic data to be introduced.
The methods for the operations per column assume that for each column in the year of reporting t the same kind of data will in principle be avialable as in t-1.
For the compilation of the complete and completely specified set of data for the column which forms the point of departure for the balancing, a number of methods are available, i.e. for each category of basic data a standard method with one or more alternatives. Most methods only give a satisfactory result if the data to be introduced for t are comparable with those of t-1.
If the available data for year t are not comparable with those for t-1, three solutions are available:

- differently estimated totals are introduced for the entire column;
- for period t data are estimated which are comparable with the available data for t-1;
- for period t-1 data are estimated which will make them comparable with the available data for t.

The first method actually differs little from a hand-operated completion of the second or third method. The second method seems practicable in particular in the event one of the basic data for one reporting year is not available.
The third method will be used on a fairly large scale in cases where new statistics become available. In the first year of their existence new statistics usually experience teething troubles and also frequently become available relatively late. They often can only be used from the second reporting year on and with some additional effort with regard to the data for t-1 the third method is applicable. The estimate then takes place as follows. In pursuance of the newly introduced data for t-1, the set of data, to be provided for balancing is again determined for t-1. The balancing for period t-1, however, is not carried out again. The relationship between the new data before balancing and the balanced result for t-1 is determined and this relationship then is used in period t. It is then a question of processing the data introduced for t in the same manner as for t-1, including an adjustment in view of the relationship between data before and after balancing t-1.
This method provides the best approximation of the change of the input-output elements on basis of the latest data. The continuity is therefore not affected. In annex 2 more detailed attention is paid to these matters in the system.

6.3.4. Accuracy

To determine the accuracy of the final estimates after integration is particularly difficult as some adjustments to the basic statistics during the integration process increase the quality, while other adjustments reduce it.
There is a clear increase in accuracy for those variables in the input-output table that are measured twice.

Others are only estimated once by a variety of methods such as private final consumption, which is estimated by virtue of the production statistics of consumption goods, data on sales by the retail trade and on the basis of budget inquiries among households. Other data again are perforce estimated as residual item of the system.
In all cases the use of the interdependence of data provides a means for quality improvement of results of separate statistics or of data which otherwise would have to be separately estimated in a more approximate manner.
On the other hand the quality of basic data is reduced when there are data that are adjusted in the integration process because they do not entirely comply with the definition and classifications of the input-output table. Moreover additional estimates for non-observed activities imply that data with a wider coverage are less accurate than the observed data.
A conclusion from the above is that it is in practice not feasible to assign quantitative margins of accuracy to data of the input-output tables. This applies to the estimates of the changes in the time series, as well as to the estimated levels. In practice input-output data are derived from a combination of accurate statistics, very rough estimates and all kind of variations in between. If this heterogeneous basic information is amalgamated into a complicated system of interdependent estimates the accuracy of the variables resulting from this integration process cannot afterwards be related any more in a simple manner to the accuracy of the separate basic statistics. It is nevertheless clear that it is of interest to users of integrated data to obtain some measure of accuracy of the final estimates, even if such measure only reflected the statistician's subjective point of view. It is likely, however, that the needs of various categories of users are widely divergent. Those making intensive scientific use of the data will perhaps benefit most from a combination of a detailed description of the estimation methods and the statistician's subjective opinion regarding the details of the estimating process.
Others only want a global indication of the accuracy of the final result. It is therefore extremely difficult to find one most appropriate measure of accuracy, not least because the statistician himself often has a distorted picture of the accuracy of the estimates.
The system may, however, be of help. For the benefit of the balancing process per column margins of reliability are attributed to all elements of the table.

The estimates of these margins are derived from:

- reliability indicators for the basic data introduced into the computer ;
- accounting rules which are applied to the reliability measures in each stage of the estimation process (in this respect there is question of weighing by the extent of the adaption - e.g. additional estimate or splitting - or the original figure).

For the time being these possibilities are only used with the exclusive aim of optimal balancing. This means that this by itself will not provide reliable indications of accuracy for the users of the statistics. The reliability margins may have been manipulated in order to arrive at the desired balancing result. This balancing result is moreover determined by the relative accuracy so that the user of the system will for a start not be in the least concerned about the absolute level of the margins of accuracy.
Presently, it is intended to make a start with a very simplified use of the possibilities. To begin with, in respect of the basic statistics a distinction is only made between four reliability groups and for the final estimates between at most eight groups.
The system nevertheless seems practicable as a means for making more explicit the statistician's opinion as to the accuracy of the results. It is conceivable that by way of trial and error in the long run a method will be developed to quantify properly the reduction in reliability as a result of the processing of the basic data. The calculation of the increase in accuracy by way of a double approach will have to become the subject of research at a later stage.
Such improvement of measuring the accuracy may be based on the extent to which corrections are made within the framework of the balancing proces.
In order to achieve this, real margins of reliability may have to be assigned to the row totals (see annex 2 on "negative balancing").
However, the most important condition for the calculation of the accuracy of the final estimates will turn out to be the availability of estimates of the accuracy measures for the basic data.
Particularly because in a smal country like the Netherlands it is often not a matter of large numbers of informants and because of important problems of definition - differences between business management and national accounts definitions - this remains a very precarious matter. This is even more accentuated by possible distortions on account of the existence of a hidden economy.

6.4. Final remarks

In this chapter the personel problems and the transition problems connected with the introduction of the computerized compilation procedure have not been considered.

Since the system is still being developed, not yet sufficient experience has been accumulated in order to make a realistic appraisal. It is intended, however, to give in a few years' time a detailed description of the system once it is operational; attention will also be paid to the aspects just mentioned.

Annex 1. Some practical problems related to the maintenance of continuity in time series

In this annex further consideration is given to the problems discussed in 5.2. with regard to the maintenance of continuity in time series, in the course of which the questions posed in 5.2. will be illustrated with some examples.

Example 1 - should the relative or the absolute change over time be estimated accurately (question 1)

Example 2 - what is the accurate estimate of a component of an aggregate and at what level of aggregation should the estimate be accurate (question 2)

Example 3 - what is an accurately estimated relative change over time in an integrated system (question 3)

Example 4 - other problems related to the determination of the relative change over time

Example 1 - absolute change or relative change

Assume : X_w^t = actual value, element X, period t

X_ν^{t-1} = estimated value, element X, period t-1

(X_ν^{t-1} forms part of the time series and X_ν^t must be estimated in comparison with it)

$X_w^{t-1} = 40$; $X_w^t = 80$; $X_\nu^{t-1} = 20$

Question : Which value must be estimated for X_ν^t

Elaboration: If it is desired to make an accurate estimate of the absolute change, the following applies:

$$X_\nu^t = X_\nu^{t-1} + (X_w^t - X_w^{t-1}) = 60$$

If it is desired to make an accurate estimate of the relative change, the following applies:

$$X_\nu^t = X_\nu^{t-1} \cdot X_w^t / X_w^{t-1} = 40$$

In practice the accurate estimate of the relative changes will receive priority.

Example 2 - relative change - which level of aggregation

Assume : $X_w^{t-1} = 40$; $X_w^t = 80$; $X_\gamma^{t-1} = 20$

$R_w^{t-1} = 40$; $R_w^t = 40$; $R_\gamma^{t-1} = 40$

$\sum_w^{t-1} = 80$; $\sum_w^t = 120$; $\sum_\gamma^{t-1} = 60$

Question : Which values must be estimated for X_γ^t and $\sum_\gamma^t$ (these values must be comparable with X_γ^{t-1} and $\sum_\gamma^{t-1}$).

Elaboration: Assuming an accurate relative change of X, the following applies: $X_\gamma^t = 40$ (see example 1).

Assuming an accurate relative change of the aggregate ($\sum$) the following applies:

$$\sum_\gamma^t = \sum_\gamma^{t-1} \cdot \sum_w^t / \sum_w^{t-1} = 90$$

In this case the result for X_γ^t would be a value of 50 ($\sum_\gamma^t - R_\gamma^t$) and this does not result in an accurate relative change for X.
At other levels of aggregation we can always find different values for X_γ^t. It is therefore necessary to define at which level of aggregation it is desired to have an accurate estimate of the relative change and when this choice has been made, it is good to realize that the relative change at a different level of aggregation need not be accurate.

Example 3 - relative change in input-output table

Assume :

Matrix X^{t-1} (= (x_{ij}^{t-1})): input-output table, actual value, period t-1

	j = 1	j = 2	Σ
i=1	50	50	100
i=2	50		
Σ	100		

Matrix X^{t} (= (x_{ij}^{t})): input-output table, actual value, period t

	j = 1	j = 2	Σ
i=1	50	60	110
i=2	40		
Σ	90		

Matrix Y^{t-1} (= (y_{ij}^{t-1})): input-output table, estimated value, period t-1

	j = 1	j = 2	Σ
i=1	45	75	120
i=2	35		
Σ	80		

Question : Which are the correct estimates for the elements in the matrix Y^t (=y_{ij}^t): input-output table, estimated value, period t. This table must be comparable with the input-output table, estimated value, period t-1 (Y^{t-1}).

Elaboration: For y_{11}^t the following estimates may be made:

- as direct estimate:

$$y_{11}^{t} = y_{11}^{t-1} \cdot x_{11}^{t} \;/\; x_{11}^{t-1} = 45$$

- as residual estimate on the row:

$$y_{11}^{t} = \sum_j y_{1j}^{t} - y_{12}^{t} = \sum_j y_{1j}^{t-1} \cdot \sum_j x_{1j}^{t} \;/ \sum_j x_{1j}^{t-1} - y_{12}^{t-1} \cdot x_{12}^{t} \;/\; x_{12}^{t-1} = 42$$

- as residual estimate in the column:

$$y_{11}^{t} = \sum_i y_{i1}^{t} - y_{21}^{t} = \sum_i y_{i1}^{t-1} \cdot \sum_i x_{i1}^{t} \;/ \sum_i x_{i1}^{t-1} - y_{21}^{t-1} \cdot x_{21}^{t} \;/\; x_{21}^{t-1} = 44$$

At least three estimates are therefore possible for y_{11}^{t}. The direct estimate of the element is in this case higher than the two residual estimates, which shows that estimating items residually may be risky.

For y_{12}^{t} and y_{21}^{t} different estimates may also be made:

- as direct estimate: $y_{12}^{t} = y_{12}^{t-1} \cdot x_{12}^{t} / x_{12}^{t-1} = 90$

$$y_{21}^{t} = y_{21}^{t-1} \cdot x_{21}^{t} / x_{21}^{t-1} = 28$$

- as residual estimate where y_{11}^{t} is also residually estimated (average of the residual estimates in row and column)

$$y_{12}^{t} = \sum_j y_{1j}^{t} - y_{11}^{t} = 132 - 43 = 89$$

$$y_{21}^{t} = \sum_i y_{i1} - y_{11}^{t} = 72 - 43 = 29$$

- as residual estimate where y_{11}^{t} is estimated directly

$$y_{12}^{t} = \sum_j y_{1j}^{t} - y_{11}^{t} = 132 - 45 = 87$$

$$y_{21}^{t} = \sum_i y_{i1} - y_{11}^{t} = 72 - 45 = 27$$

However, other estimates are possible.
Depending on the strategy of continuity pursued, (which assigns higher priority to the accuracy of some input-output elements and a lower one to the accuracy of others) a choice will have to be made between the alternatives. Such a choice is even more complicated by some other factors. The above example assumed complete independance of the input-output elements to be estimated.
In practice this assumption is not satisfactory as there exist input-output relations between the elements within the rows and columns.
It is furthermore possible that for specific cells no direct estimate can be made because reliable data are not available. In this latter case it is tempting to estimate the cells concerned residually, but this may be risky. Assume that in the example row 2 relates to operating surplus, and column 2 to private final consumption and that no reliable independant basic data are available for these items. Residual estimation based on the last mentioned alternative 3 would result in underestimation of both the national income and the consumption and this underestimation is not compensated elsewhere.
It is important to determine under which circumstances such underestimates or overestimates would occur.

Example 4 - Problems related to the determination of the relative change

In the examples given it has always been assumed that the actual value for the period t-1 could be prepared without any problems. However, this is by no means always so and in many instances it will only be possible to make proper use of a new information source if data covering a number of years are available.

Assume : X_w^t = actual production value, row X, period t

X_γ^{t-1} = estimated production value, row X, period t-1

(X_γ^{t-1} forms part of the time series and X_γ^t must be estimated on basis of it)

- X_1 and X_2 refer to the production values in rows 1 and 2 of an input-output table, classified by activities. The enterprises are classified by their main activity.

- B_1, B_2, B_3 are enterprises.

- Assume as is shown that enterprise B_2 in t-1 has been classified erroneously under X_2.

Classification of enterprises		
	t-1	t
X_1	B_1	B_1, B_2
X_2	B_2, B_3	B_3

Production values		
	t-1	t
B_1	20	40
B_2	10	20
B_3	30	30

Question : Which values must be estimated for $X_{1\gamma}^t$ and $X_{2\gamma}^t$ that are comparable with $X_{1\gamma}^{t-1}$ and $X_{2\gamma}^{t-1}$ (20 and 40 resp.).

Elaboration: If for $X_{1\gamma}^t$ and $X_{2\gamma}^t$ the actual levels of 60 and 30 resp. are used a discontinuity arises. In this case the erroneously classified enterprise B_2 remains included for period t-1 in row X_2 and for period t in row X_1.

A second alternative is to reallocate B_2 in t to row X_2 so that for both years the classification is comparable. In that case the values for $X^t_{1\gamma}$ and $X^t_{2\gamma}$ are 40 and 50 resp.

This solution is also not satisfactory, however, as X_2 would increase from 40 to 50, which is in conflict with the no-growth of X_2, when in conformity with the latest information, X_2 would consist for t-1 as well as for t only enterprise B_3.

- The following seems to be the best alternative:

  B_2 is included in t-1 in X_1, so that under this alternative also both years have a comparable classification. The difference with the second alternative is that the "correct" classification according to the latest information has now been applied. There is, however, the problem that X^{t-1}_{1w} departs from $X^{t-1}_{1\gamma}$.

  The best estimate is for $X^t_{1\gamma}$ is now:

  $$X^t_{1w} \,/\, X^{t-1}_{1w} \,.\, X^{t-1}_{1\gamma} = 60 \,/\, 30 \,.\, 20 = 40$$

  and for $X^t_{2\gamma}$:

  $$X^t_{2w} \,/\, X^{t-1}_{2w} \,.\, X^{t-1}_{2\gamma} = 30 \,/\, 30 \,.\, 40 = 40$$

  In these cases the correct changes have been applied to the incorrect levels (remaining are, the problems cited in example 2 with regard to the levels of aggregation).

  A disadvantage of this alternative is that the method proposed is in practice difficult to carry out if input-output tables are compiled manually. If the integration process is computerized, this disadvantage hardly applies any longer (see 6.3.3. and annex 2: 2.5.2. - R3 column).

  In the foregoing it has always been assumed that interference with the continuity was always clear. In reality this is by no means always the case. It is appropriate to make a distinction between "actual" changes and "technical" changes. Actual changes are the result of e.g. the establishment or going into bankruptcy of an enterprise. Technical changes are caused by such technical factors, as a modified classification (see example), different definitions, improved statements by informants, different questions, etc. Actual changes should be reflected in the time series, technical changes should not.

  In practice it is not always easy to separate "technical" and " actual" changes. A problem arises, for example, if an enterprise in t-1 were properly classified under one activity and transferred to another activity in t because of a change in its main activity. Is this a technical or an actual change? While in practice a shift may have occurred between principal activity and secondary activity from e.g. 60% - 40% to 40% - 60%, the classification criteria result in a shift from

100% - 0% to 0% - 100%.
The shift in itself is an actual change but its result leading to a change in row for the entire enterprise seems a technical change. Insofar as shifts of this kind occur systematically in one direction and/or involve small numbers of enterprises per row, this problem should not be neglected.

Annex 2. Computerization of the compilation of the input-output table

2.1. Introduction

In this annex the computerized system, of which the broad lines were indicated in par. 6.2., will be discussed in greater detail. It would lead too far to describe the system exhaustively in all its details; nor is it possible to pay attention to all the statistical-technical and organisational problems which have occurred in the course of the years in the development of the system. This contribution is aimed at providing a rough idea of the functioning and the interrelationship of the various parts making up the system. The reader may wish to use the flow charts that are attached.

2.2. The main systems

The computerized system for the compilation of the input-output table has been built up from eight main systems.

1. Basic table
2. Correlation collection
3. Tariff collection
4. Code collection
5. General data input
6. General data processing
7. Balancing
8. General table print out

Systems 1 to 4 supply the data bases that are used in the systems 5, 6 and 7.
These data bases are largely compiled manually; some parts are automatically derived from other data.
The processing proper takes place in the main systems 5, 6 and 7. This distinguishes between mechanical processes of executing the programmes and human actions that include the manual input of data and in particular the manual checks on the functioning of the system. Specialists and integrators assess the processes carried out by the computer and adjust them, if necessary.
Part of the apparatus for this purpose is supplied by the computer. The processes in the main systems 5 and 6 relate to the introduction and checking of data and the carrying out of processes with the aid of basic source data up to the completion of a first estimate of the input-output table.
In the main system 7 the various data are adjusted to each other while the main system 8 takes care of the presentation of the output.

In the description which follows the emphasis will be placed on systems 5, 6 and 7, and data collections 2, 3 and 4 will be discussed when they are used in 5, 6 and 7. No further attention will be paid to system 8.
First of all, the main system 1, i.e. the basic table, will be discussed. This provides the opportunity to highlight some points of departure which are of interest to the further process; at the same time an impression will be given of the table which, after due balancing in system 7 will become available.

2.3. The basic table

The manually prepared table for the year 1972 with 60 branches of industry is the point of departure for the once and for all manually compiled basic table; before entering into the function of this table, first its compilation will be discussed.
As stated in chapter 3 of the paper, the processes carried out by the specialists with source material take place in a very detailed manner. The manual implementation of the integration process, however, could only be carried out at a higher level of aggregation (60 branches of industry).
For the computerized integration a breakdown was feasible according to a table with appr. 200 industry groups. Various considerations have led to the selection of these 200 industry groups:

- the available production statistics
- industry groups with specific estimation problems
- industry groups with labour specific compilation procedures
- not too detailed because otherwise the detail would become impracticable.

Afther this table was completed, a further breakdown of the rows was prepared according to commodity groups for each industry group.
The most important criterion in the compilation of commodity groups was that commodity groups contain articles which as regards their destination are as homogeneous as possible.
A commodity group is in principle built up from two rows: one for domestic production and one for the competitive imports. It may be necessary to extend the number of rows, e.g. when a commodity is produced by more than one industry group. Another criterion for distinguishing rows within commodity groups is the homogeneity of the taxes and trade margins affecting the goods; in par. 2.6.1. its importance will become clear when an estimate is made of the supply at purchasers'prices.
A table consisting of 1.000 commodity groups and 200 industry groups was thus created, or rather a series of basic tables, i.e. one for each component of the total value (approximate basic value, trade margins, import duties etc.); from these the basic table is then obtained through aggregation.

The most important function of this table is that it provides complementary information insofar as the data in the reporting year are incomplete and/or insufficiently specified. As is apparent from the flow chart, in the future the basic table will be obtained for year t after conversion of the final tables from year t-1.

2.4. General data input

The function of this main system is to collect and check all source material which is used for the compilation of the input-output table. It is not only a question here of supply and use data for each industry group but also of information regarding final demand categories and kinds of primary costs. For the sake of convenience the data are arranged by industry groups. The input of the system is prepared by specialists; all the basic data collected, are checked against continuity.
Sometimes these data have to be pre-processed. This occurs in particular for industry groups which are prepared with the aid of very specific basic data or by means of special procedures; in view of this specific character it has been decided to produce the data for these industry groups in the specification of the basic table and pre-process them in such a manner that they are suitable directly for the purpose of balancing.
Other pre-processing manipulations which have to be carried out relate to the calculation of the value of changes in stocks, production and consumption. This occurs among others with regard to the data for the production statistics of large enterprises from which the correct change in stocks can frequently be calculated by means of quantity data. If data in respect of changes in stocks are absent, it will always be assumed that production and consumption equal sales or purchases respectively. These calculations can be carried out at a more detailed level than is required for additional processing. After the pre-processing manipulation the computer aggregates the results into the desired industry group classification. The greater part of all data will be introduced manually (by way of punching documents or directly by way of the key board); if the material is produced by information carrier which can be read automatically, it can immediately be entered into the computer. The number of data of the latter type will increase considerably in future years on account of the increased use of information-processing equipment in the compilation of basic statistics.
For each industry group the following information is provided individually for output and input for the year of reporting:

- each observation is accompanied by a code number from which can be inferred the source (large enterprise production statistics, small enterprise production statistics, wage total for the purpose of additional estimates) of the data;

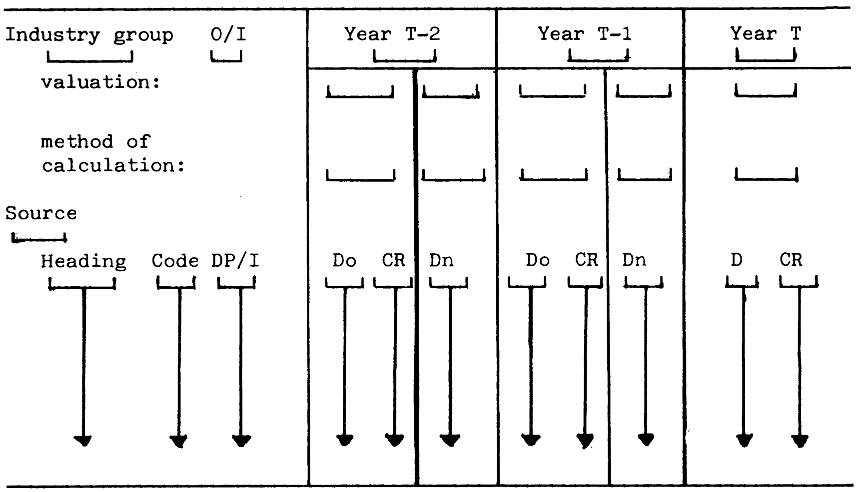
- at the same time a heading (a number of source data which go together according to a specific characteristic) and a sub-heading are provided so that the data may be identified within the source.
- the valuation(basic value, purchasers'value)in which the data are available. Data may be provided in any desired valuation;
- the value (the amount);
- an indication as to their reliability; this corresponds to a distinct relative variance. They play a role in the balancing;
- the method of calculation; this is linked to the source and determines how it is possible to convert from data at observation level to data at commodity group row level.

In addition to data concerning the year of reporting all data concerning the base year were also transferred. These are required because many methods of calculation make use of them, The data of the year preceding the base year are copied as well. They play a role in the plausibility checks which are still to be discussed.

Such data as were introduced are all checked by the computer. Thus, for example, in respect of data which were introduced with an arbitrary code the necessary checks are carried out to ascertain whether this form of coding appears in the correlation collection (see par. 2.5.).
As stated before, it is also possible to provide data in the system's commodity group coding. These codes are checked in the code collection system (see end of par. 2.4.).

Once all data have been introduced, a number of synopses are extracted from them for the benefit of the checks by the specialists. The most important synopsis shows the observations for a number of years (at most three) for each source in juxtaposed form in a pre-arranged manner. Thus it is possible to take care in particular of irregularities in the development of specific data. It may be necessary (see par. 2.5.) to introduce a new set of base year data (Dn) in order to ensure the correct processing of the data for the year of reporting.

They are naturally printed out as well. The lay-out of the table extracted is as follows:



Do: originally introduced data; D: data introduced for the year of reporting;
Dn: new data for the base year; O/I: output/input; CR: class of reliability;
D of year T is compared with Dn or with Do from year T-1; only in the latter case is it possible to make a comparison with Dn or Do from year T-2.

After completion of the checks by the specialist alterations may still be effected, after which a start can be made with the processing of the data.
Before entering into this the code collection referred to above will first of all be briefly considered.
In the code collection data are included which cannot meaningfully be accommodated under any of the other data collections. The data can be subdivided into two groups:

I. data playing a role in the operations (including checks); under these come all commodity group codes, industry group codes, other column codes and all valuation codes. Included are also a number of indications for each commodity group which are of interest in the balancing.
II. information enabling the desired tables to be formed (texts of rows and columns, forms of aggregation, etc.).

2.5. General data processing

When calculating production and consumption, basic data from various sources may be used for each industry group. In view of the divergent nature of these data, several

procedures are required, proceeding from the data introduced for each source, in order to arrive at the best possible specification (in the detailed treatment of the basic table) of production and consumption of that part of the industry group to which the source refers.

As an example may be mentioned the production statistics of the large enterprises which go into great detail, as against the limited information available for very small enterprises generally on wage totals only.

In order to be able to process the basic data per industry group successively and as well as possible, a number of subcolumns have been created, each of them with a standard method and sometimes with several alternatives.

Depending on the type of operation that has to be carried out the data of a source are introduced into a specific subcolumn of the system (see 2.4.).

In the previous paragraph these subcolumns were already implicitly encountered, but in order not to anticipate matters the discussion was in terms of sources within the meaning of production statistics. The indication which, together with the data, has to be put forward, relates, however, to the system's subcolumn which is going to be used for these data!. The choice of the subcolumns to be used has been made by the specialists. The aim has been to provide similar sources for each industry group in the same subcolumn. It is possible to use the same subcolumn for several sources per industry group.

Before further discussing the functioning and choice of the subcolumns in 2.5.2. consideration will first be given in 2.5.1. to an aspect which is given priority in the course of the data processing, i.e. the recoding.

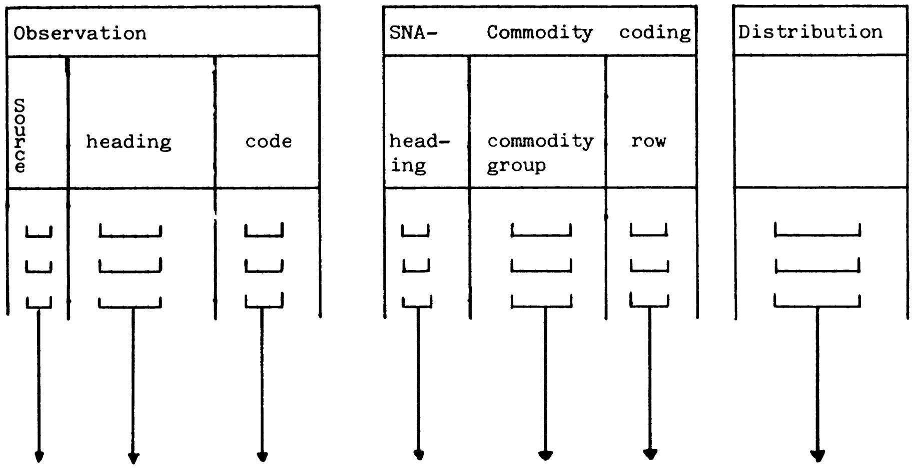
2.5.1. The correlation collection

The form of coding in which the basic data are presented may be arbitrary; when the data must undergo the operations per subcolumn they must be provided with a coding of commodity group rows, commodity groups or combination of commodity groups (heading) which can be used by the system. If they are used for the purpose of balancing, they will have to be provided with a uniform commodity group row coding.

It is the function of the correlation collection to establish the relationship between the arbitrary code per observation with the coding used by the computerized system. By including these relationships in this data collection it is possible to avoid the situation whereby alterations in the coding of the observation would make it necessary to adapt the programming. The correlation collection of year T is obtained, first of all by copying its equivalent for year T-1 and next by applying the changes in T in comparison with T-1.

The structure of the correlation collection may be presented as follows:

Year Industrygroup O/I



Three blocks are distinguished:

1. Data concerning observation: the source indicates which subcolumn of the system is used in the introduction of the data; the heading and the code identify the data within that subcolumn.
2. The commodity coding as used by the computerized system. The headings may differ from one industry group to the next but must be the same for the different subcolumns for each industry group. The heading classification per industry group is laid down in the correlation collection of the T3 column forming part of that industry group (see 2.5.2.).
3. A block distribution in which information can be included for the purpose of distributing observations over commodity groups/rows. The provision of a distribution key which might be required, is not necessary. It may, for example, also be derived from the basic table. (See discussion in 2.5.2.).

The column distribution is only used in cases where the data observed are less detailed than required by the commodity group classification. Cases will naturally also arise where the basic data are more detailed so that the commodity group data may be obtained by aggregation. Although in the headings of the table are industry groups, which are primarily used for the classification of information from the questionnaire on production statistics, they are also used for the classification of primary costs and final demand categories. As an example of this may be mentioned the allocation of B-numbers of imports to imports rows of the different commodity groups or the allocation of B-numbers of exports according to commodity groups, after which the distribution over the lines is determined by the computer.
The correlation collection is fixed for output, as well as for input.

2.5.2. Increase/specification of the data

Once the data haven been recoded, a number of complementary operations will generally still be required before all information is available in the specification of the basic table. These operations do not only relate to the breakdown of aggregates but also, to carrying out additional estimates of data, insofar as they have not been included in the statistics.
Consideration will be given to the standard and important alternative procedures that will be available in the different subcolumns in order to carry out the above mentioned activities and to the kind of data which will generally be introduced in the various subcolumns.

For the purpose of processing the data 12 subcolumns are distinguished in the computerized system whereby a distinction is made between seven columns for the inclusion of data (B1 - B4 and R1 - R3) and five columns for other purposes (T1 - T3, V and C.).

The B1 column

This is the most often used subcolumn intended for the most detailed data; in this column the data of the production statistics of the large enterprises are generally processed. Specific large enterprises may be excluded from this and be processed separately (see the column B3). It also includes the final estimates of those industry groups which are still fully pre-processed manually.
The standard method applied in this subcolumn is in principle identical for production and consumption: the data may be entered in any detailed form desired and are broken down after recoding with the aid of ratios from the T3 column (total column of this industry group after balancing from year t-1). The point of departure is that the wage total of these firms is in any case available so that this information on the consumption side is not obtained through artificial breakdown but directly from observation.

The B2 column

It is in this column that the data from the production statistics of the small enterprises will in general be processed. This is best achieved if its specification is the same as that of the data entered in the B1 column or any aggregation of it. Other specifications, however, can also be processed.
The standard method used for sub deviding production and consumption is according to the ratios of production and consumption within the B1 column.
The first alternative method which may be used is the breakdown of observations according to the ratios of the B2 column of the base year in the form in which it is known before the ratio breakdown of B1 has been applied.

Any further specification is derived on basis of the B1 column for the year of reporting. This method may be used, for example, if an incidental inquiry is made into the consumption of small enterprises.

Example:

Description		Base year	Year of reporting			
		B2 (before balancing)	B1	B2		
				Observation	Division B2 b.y.	Continued by way of B1 y.r.
CG1	DP	20	50	60	24	15
	I		30			9
CG2	DP	30	70		36	21
	I		50			15

A second alternative method is a variant to the first in the sense that in regard to the distribution of the observation from B2 a distribution key is used which applies first the trend in B1 between the base year and the reporting year to the distribution of B2 in the base year.

Example:

Description		B1		B2				
		b.y.	y.r. (1)	b.y. before bal.	b.y. + dev. B1 (2)	Observation	Splitting off by way of (2)	Splitting off by way of (1)
CG1	DP	40	50	20	80/80* 20=20	60	20	12.5
	I	40	30					7.5
CG2	DP	50	70	30	40		40	23.3
	I	40	50					16,7

The B3 column

The purpose of this column is to process special information separately, on the one hand because some data do not fit in with the other B columns, on the other hand because separation of specific data can improve the functioning of the procedures with

regard to the other subcolumns. The procedures which are applicable in this column correspond to the procedures of the B1 and B2 columns which were described above.
An example of such application is when a specific industry group includes large enterprises with a very special cost structure.
The data of those enterprises are in that case not processed together with those of the other large enterprises in the B1 column but in column B3. Thus it is possible to achieve that the group of small enterprises (in B2), by relating them to the B1 column, is not affected by these special consumption data.

The R1 column

This column is intended for the purpose of determining the data of the very small enterprises. The only thing known about these firms, at least to some extent, are in principle the wage total and employment in man-years.
The production is basically determined with the assistance of this wage total, while taking account of the self-employed. This is done by applying the trend of the wage quota of a comparable group of enterprises between the base year and the reporting year, to the wage quota of the small enterprises in the base year. This can be formulated in the following manner:

$$P^1_{R1} = P^o_{R1} * \left\{ \frac{W^1}{W^o} * \frac{(1+S^1 / N^1 * C^1)}{(1+S^o / N^o * C^o)} \right\}_{R1} * \left\{ \frac{P^1/W^1}{P^o/W^o} \right\}_B \quad \text{where}$$

P= production

S= self-employed

C= correction factor allocated to self-employed's wage

N= number of employees

1= year of reporting; o= base year

W= wages of employees

As regards the production and wages of the comparable group (subscript B) selection may take place from any combination of preceding B columns from the same industry group; other industry groups may also be used. The choice of the combination is the same for output and input.
The consumption is determined with the assistance of the following formula:

$$C^1_{R1} = \frac{C^1_B / P^o_{B1}}{C^o_B / P^o_B} * \frac{C^o_{R1}}{P^o_{R1}} * P^1_{R1}$$

For the purpose of determining the breakdown and level of production and consumption various alternative methods are available, in addition to the ones mentioned above; this will not be discussed in greater detail (see also B4).

The B4 column

This column is specially intended for data which cannot be processed in the usual manner with the assistance of the columns so far discussed. A first category of application relates to information concerning commodity group rows which are only known for the total industry group (often from a separate source). In the second type of application the B4 column is used as an auxiliary column for the determination of a part of the R1 column. In that case the total data are provided in the B4 column for those components for which information is also available from the columns B1 and B3; the difference between the totals provided and the information available in the preceding columns is then transferred to the R1 column.

The R2 column

This column has the possibility of creating additional information for specific industry groups which does not fit in with the preceding B and R columns. This column is distinguished in application from the B3 column in that the data provided in the latter column can in fact play a role for the purpose of determining the increase in the R1 column. The information in the R2 column will often relate to increases for purely statistical reasons. The data in this column are basically divided proportionally to the B1 column. As an alternative, however, the procedures of the B3 column also apply.

The R3 column

Given the need for continuity it may sometimes be necessary to make the original data of the base year consistent with those of the year of reporting.
This may occur, for example, if an enterprise changes from one industry group to another as a result of a reclassification of the register of enterprises; for the base year new data relating to the same enterprises will then have to be introduced and processed. Once the subcolumns of the base year have been recalculated, the total column before balancing (T1: total of the B and R columns) which is consistent with the T1 column for the reporting year can then be determined again.
The objection to this approach is that undesirable differences in the V column (=T3-T1) arise as a result, since the total column after balancing (T3) should not be altered. In principle this V column should only contain the actual balancing corrections; in certain cases these are used as distribution key in the year of reporting (see discussion of V column) for which reason they must not be distorted by other corrections.
The resulting problems are solved by adding the R3 column to the system and by then using it as follows:

1. For the base year the R3 column is defined as the difference between the old T1

column and the total of the revised versions of the B and R columns.

2. The R3 column of the year of reporting is calculated with the assistance of the data calculated under point 1. For the distribution of the totals to the component parts the point of departure will basically be the ratios of the R3 column in the base year.

This may be illustrated with help of the example which was earlier described in the context of annex 1 (example 4: problems in estimating the relative changes). Assume the original data for the base year (t-1) of the industry groups X_1 (including enterprise b_1) and X_2 (enterprises b_2 and b_3) are as follows:

t-1 (original)

	X_1				X_2			
SNA code	B1	T1	V	T3	B1	T1	V	T3
101	8	8	-1	7	14	14	+2	16
102	3	3		3	8	8	-1	7
103	5	5	+1	6	9	9	-1	8
W	4	4		4	9	9		9
Σ	20	20		20	40	40		40

In year t it becomes apparent that enterprise b_2 in t-1 had been by mistake classified under X_2. For year t-1 new data must be introduced into the sub-columns concerned in such a manner that enterprises b_1 and b_2 are introduced in column B1 of X_1 and b_3 in column B1 of X_2. In this example it is assumed for the sake of convenience that only column B1 is used for the introduction of data; if data had also been introduced in other columns while the method of calculation required that during the processing of the data use would be made of the B1 column, these calculations, after the revision of the B1 column, would have to be carried out again; in that case the data of the year t-2 must not be used.

The data for the year t-1 for the industry groups X_1 and X_2 will then, for example, look as follows:

t-1 (new)

	X_1					X_2				
SNA code	B1	R3	T1	V	T3	B1	R3	T1	V	T3
101	13	-5	8	-1	7	9	5	14	+2	16
102	4	-1	3		3	7	1	8	-1	7
103	7	-2	5	+1	6	7	2	9	-1	8
W	6	-2	4		4	7	2	9		9
Σ	30	-10	20		20	30	10	40		40

The data for the year of reporting are:

	t					
		X_1			X_2	
SNA code	B1	R3	T1	B1	R3	T1
101	24	-10	14	8	5	13
102	9	-2	7	8	1	9
103	14	-4	10	7	2	9
W	13	-4	9	7	2	9
Σ	60	-20	40	30	10	40

The total of the R3 column in the year of reporting (t) is estimated with the total of R3 in t-1 and the relative mutation of the other columns (in this example only the B1 column) as point of departure. The distribution of the total over the elements is effected by making use of the column R3 ratio's in year t-1.
As a result of these procedures the columns of the base year and the year of reporting can be compared with each other.

The T1 column

This is a technical column established solely for calculating purposes, which includes the sum total of columns B1 to B4 plus R1 to R3 (except for those parts of B4 which relate to the second type of application mentioned there).

The V column

No data are introduced into this column; it is used for separating as yet undistributed items which owing to uncertainties in the basic data or lack of additional details still appear in column T1 without being distributed. In the process of distribution of such items over commodity group rows the balancing corrections of the base year act as distributive key; this is done in order to limit to a minimum the balancing corrections required in the year of reporting. In addition, an important effect of this procedure is that maximum continuity is achieved in the actual balancing corrections. The column with balancing corrections from the base year (T3-T1) will initially be assessed by the specialists and corrected, if necessary (see the C column).

The T2 column

Technical column for calculating purposes: T1 + V

The C column

This column is merely intended as a correction column to the V column which was

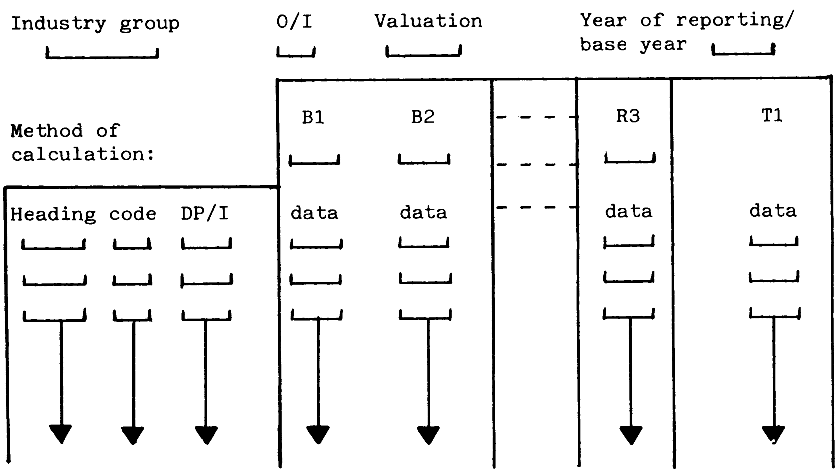
discussed above. No corrections can be made in the V column itself. The only two correction methods are:

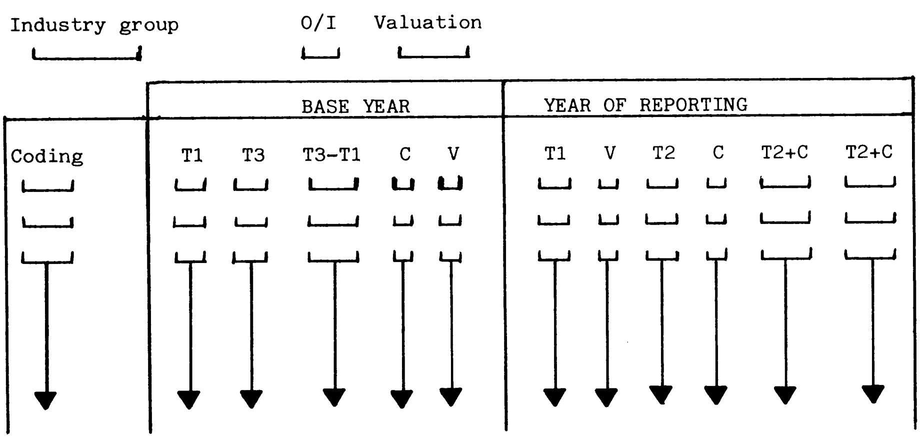
- the V column of the base year (T3-T1) can be adapted in such a manner that for the year of reporting a new column V, (T3-T1) + C, is created from the base year data.
- the data regarding the year of reporting can be corrected in such a manner that a new T2 column is created by adding the C column to the old T2 column (=T1 + V; in this case it is therefore a matter of complementing the V column!).

In the description of the most important facilities, procedures were dicussed that made use of base year data. These data therefore should be copied for processing in the year of reporting; they appear in the coding of the system. As was discussed in the processing of the R3 column, for example, it may be necessary to introduce new subcolumns with data at observation level for the base year. Since these data will have to be processed according to the normal procedures (without falling back on the data of a preceding year), the different correlation collections from the base year are also copied and modified, if required. The processing of the columns introduced for the base year precedes the processing of the year of reporting.

All data are processed in the valuation provided, but the subcolumns of an industry group in the base year and the year of reporting must have the same valuation. Since use is sometimes made of distributions in accordance with the T3 column of the base year, this T3 column is with the aid of the tariff collection converted into the valuation desired, if required. Only when the T2 column of the year of reporting which ultimately has to be fitted in has been fully completed, will it be brought into the standard valuation. The estimates after processing of the data will naturally have to be evaluated by the specialists and any intermediate results will have to be compared with corresponding base year results.

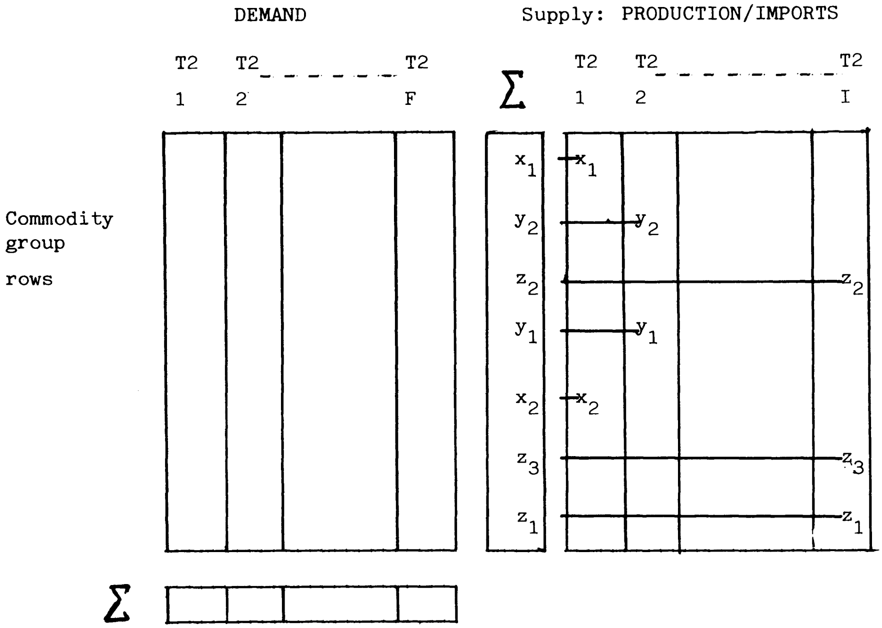
The following presentation may be submitted to the specialist:





In the last synopsis T2+C appears twice:
once (as do the data of all other columns in the scheme) in the valuation of the industry group (indicated in the heading of the table) and once in the standard valuation. Assuming that a measure of reliability is in principle assigned to each item when measured (i.e. the relative variance of the corresponding reliability class) the variances of the components calculated from the observations are also calculated in the course of the process described above (variance - unless specified differently - is understood to be the absolute variance).
This is done by applying a number of calculating rules. It is assumed that if an element is broken down in to subelements, the relative variance of the subelements will be larger than that of the original data.
The variance of the elements in the T columns is calculated by adding the variances of the elements from which the element concerned in the T column is composed. The role played by the variances in the balancing will be described in more detail in par. 2.6.. There also the different levels (combinations of commodity groups) to be balanced will be discussed.
The variances of the elements at the different levels are calculated for each subcolumn even while the data are processed, since it is possible in that process to take account of the variances of the observations corresponding to each specific level of aggregation. It can thus be avoided that a decrease in the reliability, because of a breakdown of an item mistakenly works itself out at higher levels if at that juncture, as a result of them being joined up, the (more reliable) original item were in fact to reappear. All variances calculated by the system can be printed out. Once all operations have been carried out, two matrices of T2 columns have in principle been created: one matrix with consumption data for each industry group and for each final demand category and one with supply data from domestic production and from imports. The consumption data are valued at purchaser's prices, the supply data are in basic value. All elements have a variance.
In view of the manner in which the commodity groups are compiled - a separate row for each producer and also a row for imports which are in competition with domestic production - the rows covering the matrix of supply data can be added without any information being lost in the process.
A matrix has thus been created which can be regarded as the first estimate of the input-output table. Since the row totals (resulting from consumption data) do not match the corresponding supply - apart from the difference on account of the differing valuation of consumption and supply data - the matrix must be balanced.

What has been described above may be illustrated by means of the following schedule:



2.6. The balancing

Once the available data have been introduced and processed and after the specialists have carried out checks of the final results (in addition to those of the original data and intermediate results), a start can be made with the balancing.
The function of the balancing system is that all data are adjusted to each other in such a manner (taking account of specific indications of reliability for each item) that an internally consistent table results.
The balancing system consists of three parts which will be discussed successively: pre-processing (2.6.1.), the balancing proper (2.6.2.) and post-processing (2.6.3.).
As one of the advantages of the computerized system as compared with the manual operation, chapter 6 mentioned the possibility of having the integration process assessed and adjusted, if necessary, by the specialists; for this reason attention will at various moments have to be paid to the aids the computer provides to the specialist for assessing operations carried out.

2.6.1. Pre-processing

The valuation of the various data at the moment of balancing is the purchasers' value (basic value + wholesale margins + import duties + other taxes). This particular

valuation has been chosen because most consumption data (which have led to the first estimate of the inner part of the table to be balanced) are available directly at source in this valuation. Since most supply data are available in basic values, they are entered for balancing in that valuation. Given the nature of the pre-processing it is important that all data should be revalued in basic values.

To do these revaluations here - and also in the preceding part of the compilation - a so called tariff collection system has been devised, which contains information for each cell regarding taxes and trade margins and is initially completed from the basic tables (separate tables for each form of valuation). Once all data have been converted into basic values, it is possible to start with the next phase of the pre-processing: the estimation of those elements for which no estimates have been made in the preceding part of compilation because the basic statistics were absent.

The discussion in this instance will be limited to one case: the non estimated part of household consumption and investments by enterprises.

For the purpose of drawing up the estimates use is made of the code collection system, which indicates which consumption branches (classification of consumption according to consumption functions) and investment categories (classification of investment goods) have already been estimated directly from the input data, and which branches and categories and related commodity groups still have to be estimated. If an estimate is required, also is indicated the method of estimation. A choice exists between two alternatives:

1. by a percentage (for each row) of the total supply; other percentages are also possible, e.g. a percentage of the supply available on the domestic market. The percentage method is used if it is undesirable that the elements concerned show too large fluctuations from one year to the next: the percentages have been derived from the base year.
2. as residual item; for these commodity groups the total of the non estimate private consumption and/or investments is determined as the difference between the total supply and the total known uses. Then, with the assistance of a distribution key derived from the base year, a split is first of all made if necessary according t other consumption and other investments, followed by a further breakdown of these amounts over the various rows. If the residual amount is negative, the system automatically switches to method 1.

Example:

Assume: that are five consumption branches and three investment categories.

For branche 1 and category 2 complete information is available from the data input system. The data of the column other consumption which might be estimated with help of methods 1 or 2 for each commodity group relate to branches 2 to 5; that of the column other investments to categories 1 and 3.

The code collection then inaicates, among others:

Data for the calculation of columns
other cons./other invest.

		Other cons.		Other invest.	
		Method	%	Method	%
CG1	NP1	—	x_1	residual item	y_1
	NP2		x_2		y_2
	I		x_3		y_3
CG2	NP1	residual item	x_4	%	y_4
	NP2		x_5		y_5
CG3	NP	%	x_6	—	y_6
	I		x_7		y_7
CG4	NP1	residual item	x_8	residual item	y_8
	NP2		x_9		y_9
	I		x_{10}		y_{10}

Once further information regarding consumption and investments has become available in the near future the above mentioned estimating methods can be allowed to lapse; the information can then be made completely available for each branch or category resp. by way of appropriate procedures. After the empty spaces have been filled up, the data in the inner part can again be replaced by the purchasers' value data. At the same time the purchase value of the supply will be determined by increasing the basic value by taxes and margins expressed as average percentages per row.
Once this has been done, total uses will in general not equal total supply.
If on the other hand the residual item method had been applied in an earlier phase, these differences for those commodity groups would be zero.
(Differences for each commodity group row can indeed occur, since for the distribution of the other consumption/other investments at basic value a distribution key from the base year has been used).
Next, a residual column is added in which the total difference for each commodity group is inserted; this is distributed within the commodity group over the rows of the residual column proportionate to the sum of the other row elements (example: the total difference is 10, and the first element is:

$(5 + 20)/(15 + 20 + 10 + 5) * 10 = 5$ see next page)

Before eliminating the differences for each commodity group by balancing all commodity groups, plausibility checks will first be made. As most elements have not changed since the last check, the checks to be made here relate to the elements created or adjusted during the pre-processing phase. On the one hand specialists in the field of household consumption and investments will look at the complete columns, in the course of which a comparison will also be made with the results of the preceding year; on the other hand the branch of industry specialists watch the commodity groups of which they are the main producers. For each commodity group the differences to be eliminated per row are also printed out (both in absolute terms and as percentages of the supply), as are the elements of the residual column in percentages of the supply. For the sake of convenience a number of data from the code collection are printed out which played a role during the pre-processing operations. Finally is indicated whether changes have occurred in the elements which were already known at the beginning of the pre-processing.

After the views of the specialists have been processed (which may give rise to adjustments which may or may not lead to one or more operations being carried out again) the balancing per commodity group can be started.

For the purpose of balancing a matrix (during the pre-processing this is a commodity group; during the balancing proper the total matrix - to be discussed later -, and the technical and the statistical submatrices) it is a matter of solving the following problem: eliminate the differences established as well as possible within the matrix, bearing in mind the reliability of all elements and the marginal totals which cannot be changed.

The method of solution reflects the solution to the following optimization problem:

$$\min \sum_{i=1}^{n} \sum_{j=1}^{m} \frac{(y_{i,j} - x_{i,j})^2}{v_{i,j}}$$

$$\text{on condition} \quad \sum_{i=1}^{n} y_{i,j} = k_j \qquad j=1,\ldots\ldots,m$$

$$\sum_{j=1}^{m} y_{i,j} = r_j \qquad i=1,\ldots\ldots,n$$

where X represents the matrix to be balanced

where Y represents the balanced matrix

where V represents the matrix of variances of X

where K represents the vector of totals per column

where R represents the vector of totals per row.

It ultimately boils down to the inversion of a matrix with (n+m-1) rows and columns.

In view of the special structure of this matrix a shortened method of solution could be achieved by partitioning. As stated before, in determining the balancing corrections account is taken of the variance of the elements; this is done to do justice to the fact that particular elements are considered more reliable than others. How do these variances come about? In the case of the general data input one indication of reliability per source has generally been provided which is based on the relative variance of the corresponding reliability class to which it belongs (choice from eight classes). As regards data on uses, in practice a choice is usually made out of three classes. Supply data on the other hand are given class 100 for the time being, with which a zero variance corresponds so that these data are not changed (see also negative balancing). By making available relative variances instead of relative standard deviations it is possible to prevent that in the calculation of the distribution keys for balancing the size of the item works itself out quadratically.
As a result of the operations taking place during the data processing the reliability of the data is in certain cases reduced by being transferred to a lower class. This will not happen in the event of a number of source data being added; it will, however, occur in the event of breaking down items.
If the elements and their variances in the various subcolumns have been ascertained, the variances of the elements of the totals column are determined by adding up from the subcolumns. In respect of the elements which are calculated during the pre-processing of the balancing a variance is also determined; it will not surprise anyone that this will be high.
It will be clear that the attribution of reliability indications to source data is in general subjective, as is the determination of their increase or decrease by the carrying out of operations. Experience and continued research will have to lead to refinement of the methods used.

The results of the balancing of a commodity group can be illustrated with the following example in which the situation before and after balancing is shown:

	1	2	3	4	Residual	Σ
DP1	5^{-1}	20	-	-	5^{+1}	30
DP2	-	-	10	-	2^{-2}	10
IMP	10^{+1}	-	-	5	3^{+1}	20
Σ	15	20	10	5	10	60

There is a possibility that a matrix cannot be balanced for technical-arithmetical reasons. In that case all elements of such a commodity group are changed by the computer by distributing them proportionally with the marginal totals.

The programme also includes instructions for the case that positive elements have a negative value after balancing or vice versa. In that case the balancing is carried out again with the original elements, provided the amounts which changed sign are set at zero.

In determining the purchasers' value of the supply an estimate was made of the wholesale margins etc. affecting the marginal totals. This estimate is checked after balancing per commodity group by converting the balanced data of the inner part into basic value and by checking whether the table in basic value is in complete agreement. If this is not the case, a new estimate is made of the purchasers' value of the supply and the process (estimating the purchasers' value - balancing - checking the basic value) is repeated untill no single result per row shows a deviation greater than a percentage or value provided beforehand. When the correct marginal totals have been found, the balancing is completed. The result of the preceding operations is now that for each commodity group and for all destinations (including the residual column) a distribution over DP and I (in purchasers' value) has been obtaind of which the total amounts - per row and per column within the commodity group - are in agreement with the original totals; at the same time there is agreement when all data are valued at basic value.
Once the balancing proper has been concluded (see 2.6.2.), a further balancing per commodity group will take place, as a result of which the distribution over DP and I may be altered. By arranging to have the balancing proper preceded by a balancing per commodity group it is intended to obtain as good as possible an estimate of the distribution over DP and I and thus of the total trade margin per row at the earliest stage possible. By such an approach it may be possible to prevent one or more iterative stages in the balancing proper.

After completion of the balancing per commodity group the data per commodity group will again be submitted to the specialists. In addition to the commodity groups the specialists may also have the following information available:

- how often has the balancing process repeated itself after the first basic value check; the intermediate results can be printed out for each round, if required
- what are the balancing corrections
- an indication for each round whether elements have become zero because a change in sign has occurred
- has it been decided to proceed to proportional distribution because the balancing is impossible from a technical-arithmetical point of view.

The method pursued so far has been to make a provisional estimate of supply and demand of whole sale and retail services.

At the present stage it is possible to make an improved estimate. As regards the wholesale trade, production consists of the sum of the previously calculated trade margins. For the retail trade production a number of additional calculations are required which will not be further considered here. After recalculation of the production, adaptation of consumption is necessary; in this process particular elements may be exepted.

After the trade has been revised, old and new production values are printed out, as will be the new consumption columns of the wholesale and retailtrade, as well as changes compared with the previous version (after balancing per commodity group). When the data have been assessed and found to be in order, the pre-processing operations will have been completed.

2.6.2. The balancing proper

After the data which were still lacking have been added during the pre-processing of the balancing and the balancing of the commodity groups has taken place (including the checking of the basic value) a table has resulted that is consistent in both columns and rows and expressed in purchasers' as well as basic values. However, this table still contains a residual column; what matters in the balancing proper is that the elements of this residual column should be distributed over the other elements, bearing in mind the variance of those elements. Since the nature of the basic data which has led to the different commodity group data is widely divergent, different methods have been chosen for carrying out the integration process. This has led to the information of three main groups:

Main group 1; this contains the commodity groups related to specific inputs of the different users on which information is available from the principle users*. The total amount of the residual column of the commodity groups forming part of this main group is added to the total of the final consumption/investments column.

To this main group belong commodity groups which - because items have been estimated residually - had zero elements in the residual column as well as commodity groups where these elements are indeed considerable. The balancing of the latter commodity groups can give rise to corrections within those commodity groups which subsequently work themselves out into the former. With the exeption of the consumption/

*. It is therefore the two former categories which were mentioned in par. 6.2. which are involved. (See chapter 6 of this paper)

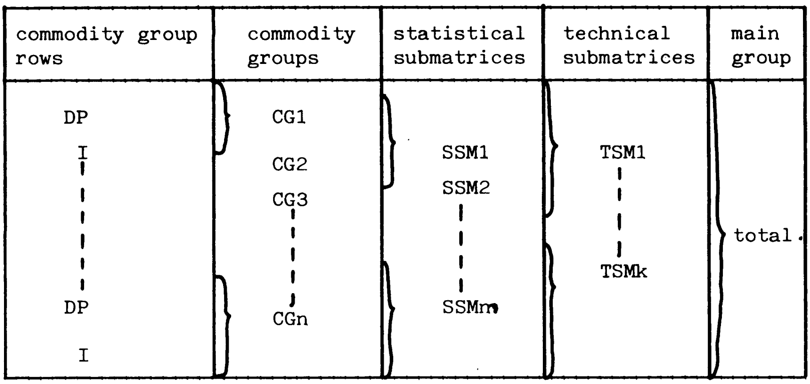
investment column the other column totals within this main group are kept constant.

Main group 2; this contains the commodity groups which are balanced in such a manner that balancing corrections, insofar as they are not cancelled out against each other, are inserted in the operating surplus per column, as a result of which the total of the other costs and operating surplus per column remains constant. It is a matter here of general inputs (other costs). This manner of integration is consistent with the manner in which these data are obtained (see par. 6.2.)..

Main group 3; to this group belong some special commodity groups which will not be further discussed here.

These main groups will be balanced successively and independently of each other. Before considering this in greater detail a problem will first be discussed which presents itself in particular in main group 1 but could also occur in main group 2. If the matrix of main group 1 were balanced in one operation, a large deviation might affect all other commodity groups directly (e.g. a large difference in a textile commodity group could result in a change in a metal commodity group). It is intended that these changes shall be made to occur as much as possible within blocks of related commodity groups (where one can be substituted for another). To this end statistical submatrices (SSM) are created consisting of commodity groups where one can be reasonably substituted for another (e.g. all commodity groups covered by packing materials).

It is thus possible to achieve that large changes can initially be kept within the statistical submatrix. At the same time it is possible to reduce the dimension of the matrix which is to be inverted for the sake of the balancing, with all the advantages this may entail. If the number of SSM is very large, a decision can be made to create technical submatrices as well, in such a manner that between the statistical submatrices within a technical submatrix there will be a larger degree of substitution than between the statistical submatrices falling outside it. This may be the case because the commodities are covered by the same heading of production statistics. The relations between the different levels may be represented as follows for main group 1:



The balancing of main group 1 now proceeds as follows:

- first of all the rows of colum totals of the technical submatrices are balanced; the residual column is cancelled after its total has been added to the consumption/ investments column (see figure a; balancing at main group level).
- next the technical submatrices are balanced one by one; the rows of column totals per TSM have been derived from the previous phase and now constitute, together with the already known row totals, the marginal totals which cannot be changed at this level (see figure b; balancing at technical level).
- each balanced technical submatrix provides new column totals of statistical submatrices; these are subsequently balanced (see figure c; balancing at statistical level).
- finally the balancing is again effected at commodity group level which makes possible a change in the distribution over DP and I for each commodity group (see figure d; balancing at commodity group level).

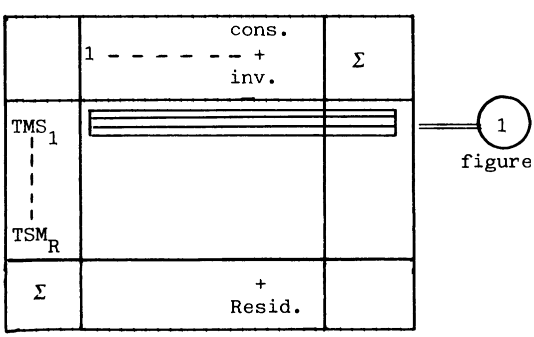


figure a; balancing at main group level

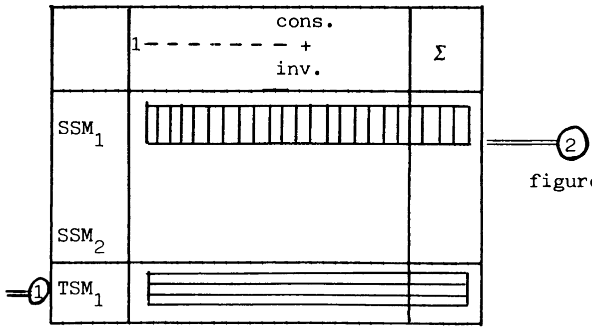


figure b; balancing at technical level: TSM_1

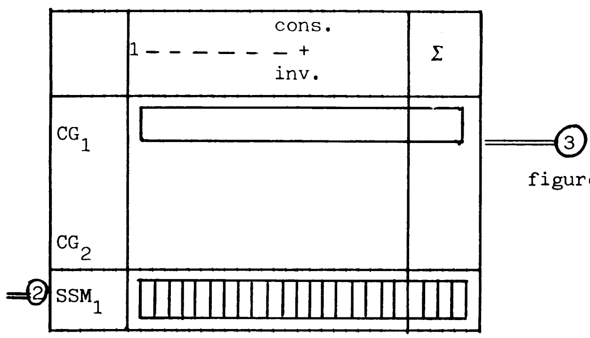


figure c; balancing at statistical level: SSM_1

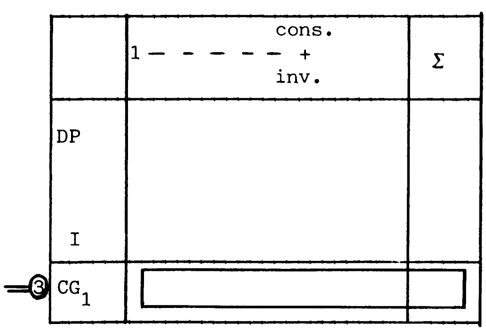


figure d: balancing at commodity level: CG_1

After the balancing at commodity group level the balancing of main group 1 has in principle been completed.
The balancing method used here corresponds with that described for the pre-processing (2.6.1.). This means that in the elimination of differences account is taken of the reliability of the elements. An essential requirement for this is that the variances

at all levels be known. In the calculation of the variances at statistical and technical level account is taken of the reliability of the data which were originally made available! This is done because the calculation of the reliability of the elements at technical and statistical level might lead to an underestimate if account is only taken in this respect of the variances of the commodity groups forming part of it.

If a basic source item is broken down into two commodity groups, the reliability is reduced; if two commodity groups belong to a statistical submatrix, the point of departure in the determination of the reliability must be the original item, and not the variances of the breakdown components; for this reason these operations take place during the processing of the data.

All this will be illustrated by an example.

Example

For the purpose of the balancing at technical level (the row of column totals of the different statistical submatrices for each technical submatrix) the variances of the different elements of the inner part must be determined, as must also, for example, the elements of the row of column totals of statistical submatrix X (SSMx). SSMx consists of the commodity groups 1 and 2. Assume element Y from the row of column totals of SSMx has been built up from the following input data:(it is assumed that only B1, the R1 and the T1 column are applicable).

Input data:

		B1	R1
CG1	DP1	50	20
	DP2		
	I	10	
CG2		20	

Variances of input data:

		B1	R1
CG_1	DP1	1	0.8
	DP2		
	I	0.2	
CG2		0.4	

The variance of the element referred to (100), bearing in mind the variances of the basic source data, is derived by adding the variances of the input data per column and by then determining the sum of these totals:

$1 + 0.2 + 0.4 = 1.6; 1.6 + 0.8 = 2.4.$

If account were only taken of the variances of the more detailed items that are derived as a result of the breakdown of the observed data from the basic statistical sources, the following situation arises:

		B1	R1	T1
CG1	DP1	30	-	30
	DP2	20	5	25
	I	10	10	20
CG2		20	5	25
				100

Variance of the split off data

		B1	R1	T1
CG1	DP1	4.8	-	4.8
	DP2	3.2	0.8	4
	I	0.2	1.6	1.8
CG2		0.4	0.4	0.8
				11.4

The variances of the elements of the T1 column are determined by the addition, which results in the variance (11.4) of the referred to earlier element.

In the balancing of main group 2 statistical and technical submatrices may also be created. As stated before, in the balancing of this main group the total of the other costs and the operating surplus is kept constant. The columns where operating surplus must not appear are exepted from this by giving their total a zero variance. In the method used here the amounts from the residual column are distributed per commodity group over the other columns and the column totals are included as a negative row in the matrix and then balanced.
The difference between this row before and after balancing then indicates the corrections which must be applied to the operating surplus; they are inserted there on a separate row. This will be illustrated with an example, which distinguishes two statistical submatrices (A and B) and assumes that final deliveries do not occur. The main group 2 which is to be balanced will then look as follows:

		1	2	3	Residual	Σ
SSM	1	15	30	-	5	50
A	2	20	5	60	-10	75
	3	-	10	25	- 5	30
SSM	4	10	5	10	- 5	20
B	5	30	-	5	-10	25
Σ		75	50	100	-25	200

Matrix to be balanced at total level:

	1	2	3	Σ
SSM A	35	45	85	155
SSM B	40	5	15	45
-Σ	-75	-50	-100	-200
Total	0	0	0	0

Matrix balanced at total level:

	1	2	3	Σ
SSM A	35	40	80	155
SSM B	30	5	10	45
-Σ	-65	-45	-90	-200
Total	0	0	0	0

This is still to be followed by the balancing whithin the statistical submatrices and within the different commodity groups. The total uses per column, as they have now been calculated, are decisive for the correction to be applied to the operating surplus. This looks as follows:

1	2	3	Σ
10	5	10	25

The operations carried out during the balancing proper will also have to be submitted to the specialists so that they may assess them.

After the pre-processing the data and the variances are printed out for each main group at the total technical and statistical level; the total of the residual column

is still visible at this stage. Before the balancing per commodity group, the balanced technical and statistical levels, are printed out again. Balancing corrections may be printed out separately. The correction row of the operating surplus will equally be printed. All corrections may be assessed by the specialists.
After the balancing per commodity group the commodity groups are made available, as are the differences in the balancing.

2.6.3. Post-processing

Once all main groups have been balanced at all levels, a start is made with a number of post-processing operations, of which only the most important will be discussed here.

The (consumption + investment) column, after the final balancing per commodity group, will then be distributed over its components, i.e. branches or categories, as the case may be. To this end use is made of the balancing method. First, a matrix is formed consisting of all columns of the consumption and investment matrix resulting from the pre-processing described in 2.6.1.. The (consumption + investment) column, as an unalterable total column, is added to this matrix. The row totals of this matrix will now in general no longer be in agreement with the values in this additional column, nor will the sum of the elements of this additional column be equal to the sum of all branch and category totals. The latter totals are inserted as negative items (with appropriate variances for each element) in a separate row of the matrix and balanced. Thus the branch and category totals automatically coincide with the total of consumption and investment combined. Here, too, statistical and technical submatrices can be introduced, after which the balancing starts at the most aggregated level. Negative line totals are operated at all levels.
After the consumption and investment matrix has been determined, a confrontation per commodity group per row once again takes place between the elements total and the corresponding marginal total in basic values. If large deviations per commodity group are found (the checks applied here will be less strict than for the checks carried out during the pre-processing in basic values), the purchasers' value of the supply from production and imports is determined again with the assistance of the new average percentages. Should it prove necessary to make a fresh estimate a start will be made again with the balancing by going back to the balancing for each commodity group in the pre-processing phase. Within the commodity groups which do agree in basic values, the rows are balanced again. For the purpose of the renewed balancing per commodity group the original amounts are taken as point of departure but this time with the new average percentages per row.
If the checks in basic values after the balancing proper only lead to small differences, these are eliminated by changing the trade margins per row in such a manner

that the basic value checks no longer produce any difference. Differences which have arisen now compared with the previously determined wholesale and retail production are compensated in the total column of consumption (and subsequently distributed over the branches).

2.6.4. "Negative balancing"

The present system assumes that in principle data on supply from domestic production and imports constitute the unalterable row totals of the matrix to be balanced, i.e. each element is given a zero variance. In specific cases it is possible to depart from this rule, e.g. if only an aggregated supply figure is known which has to be broken down over commodity group rows with help of the correlations collection system. Since there is no reason to attribute the same degree of reliability to the breakdowns as to the aggregates, they are inserted with negative sign in the inner part of the table and given a variance in excess of zero.
An example will illustrate this procedure of negative balancing which requires an additional balancing round. For the sake of convenience it will be assumed that each commodity group only has one producer and no supply from imports: it is also assumed that the difference between basic value and purchasers' value only consists of trade margins.
Assume a production item of industry group 1 (52) is distributed over commodity groups 1 and 2 (20 and 32 resp.). Together with commodity group 3 these commodity groups belong to the same statistical submatrix. For the purpose of the first balancing round the amounts concerned which have now been given a variance in excess of zero, are inserted as negative items in the inner part, with the basic value of the supply and the trade margins placed in different columns. The matrix to be balanced now looks as follows:

	1	cons. inv.	prod. 1	trade margins	Σ
CG 1	20	10	-20	-15	0
CG 2	30	20	-32	- 8	0
CG 3	20	-	-	-	25
SSM 1	70	30	-52	-23	25

Balanced, after the first round:

	1	cons. inv.	prod. 1	trade margins	Σ
CG 1	20	11	-17	-14	0
CG 2	25	19	-35	- 9	0
CG 3	25	-	-	-	25
SSM 1	70	30	-52	-23	25

Calculation of the production of industry group 1 in purchasers' value where use is made of the old margin percentages leads to the following matrix to be balanced for the second round:

	1	cons. inv.	Σ
CG 1	20	11	30
CG 2	25	18	44
CG 3	25	-	25
SSM 1	70	29	99

The difference which has arisen between the old and the new purchasers' value (in this case it is a matter of very small differences) is eliminated towards consumption + investments.
The balanced matrix after the second round looks as follows:

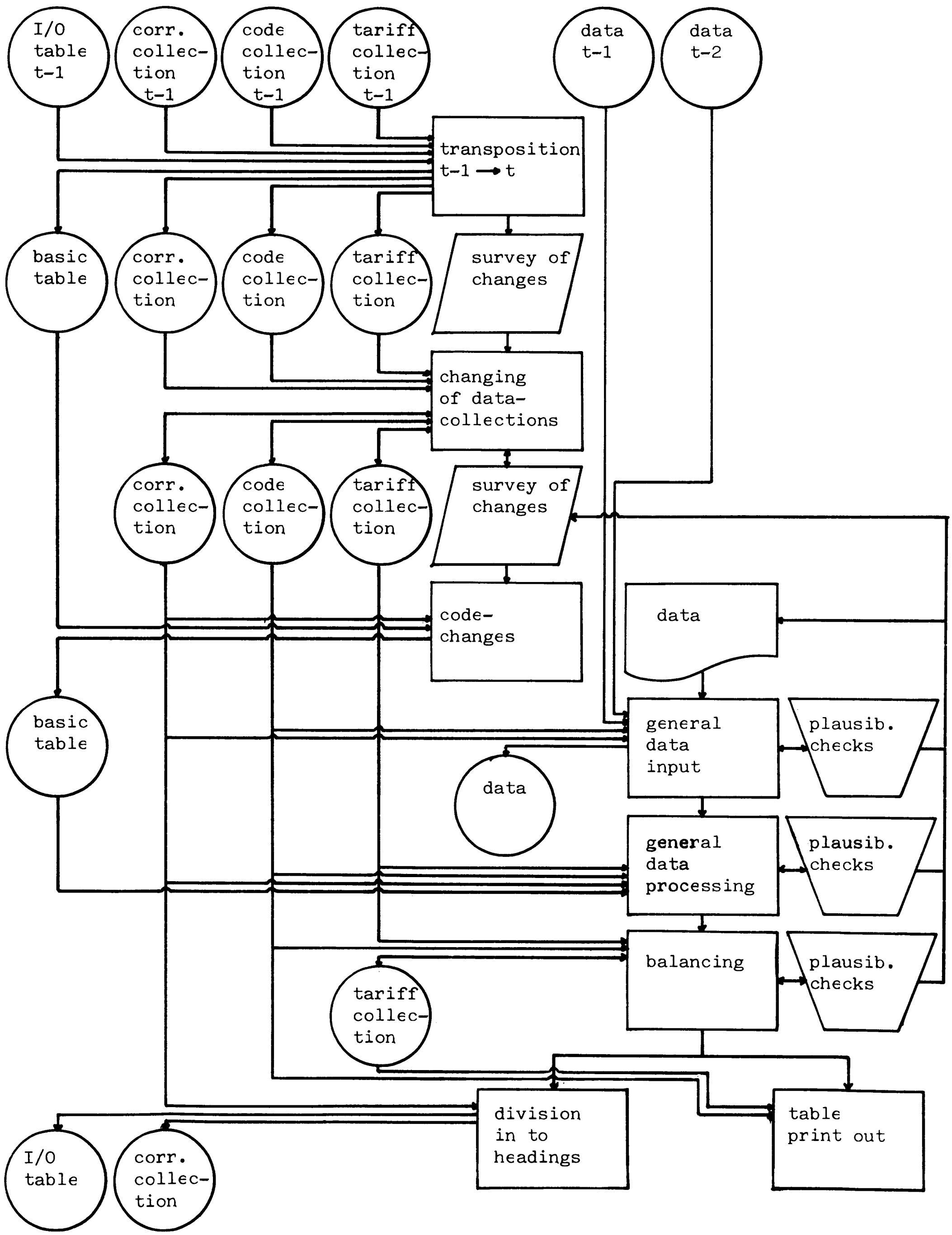
	1	cons. inv.	Σ
CG 1	19	11	30
CG 2	26	18	44
CG 3	25	-	25
SSM 1	70	29	99

The principle of the negative balancing which in the example was applied to the case where the production of one industry group was distributed over two commodity groups, can be applied on a much wider scale. Why is the supply figure unassaible if with it the same operations can be carried out in principle as in the case of consumption data? In future the rules of calculation which are applied for the purpose of determining the variance of consumption data can also be declared applicable to components of production.
Assuming that in future out of the supply data only the production totals per industry group shall be retained as a basis (var.=0), the balancing situation then arising can be represented as follows:

	Consumption				Production				
	1	2	- - - -	M	1	2	- - - -	I	
DP_1		y_2			$-x_1$				0
I_1		y_2						$-x_I$	0
DP_2				y_m	$-x_1$			$-x_I$	0
I_2				$°y_m$					0
DP_3	y_1								0
¦									¦
DP_n		y_2							0
I_n		y_2							0
	Y_1	Y_2	- - - -	Y_m	$-X_1$		- - - -	$-X_I$	

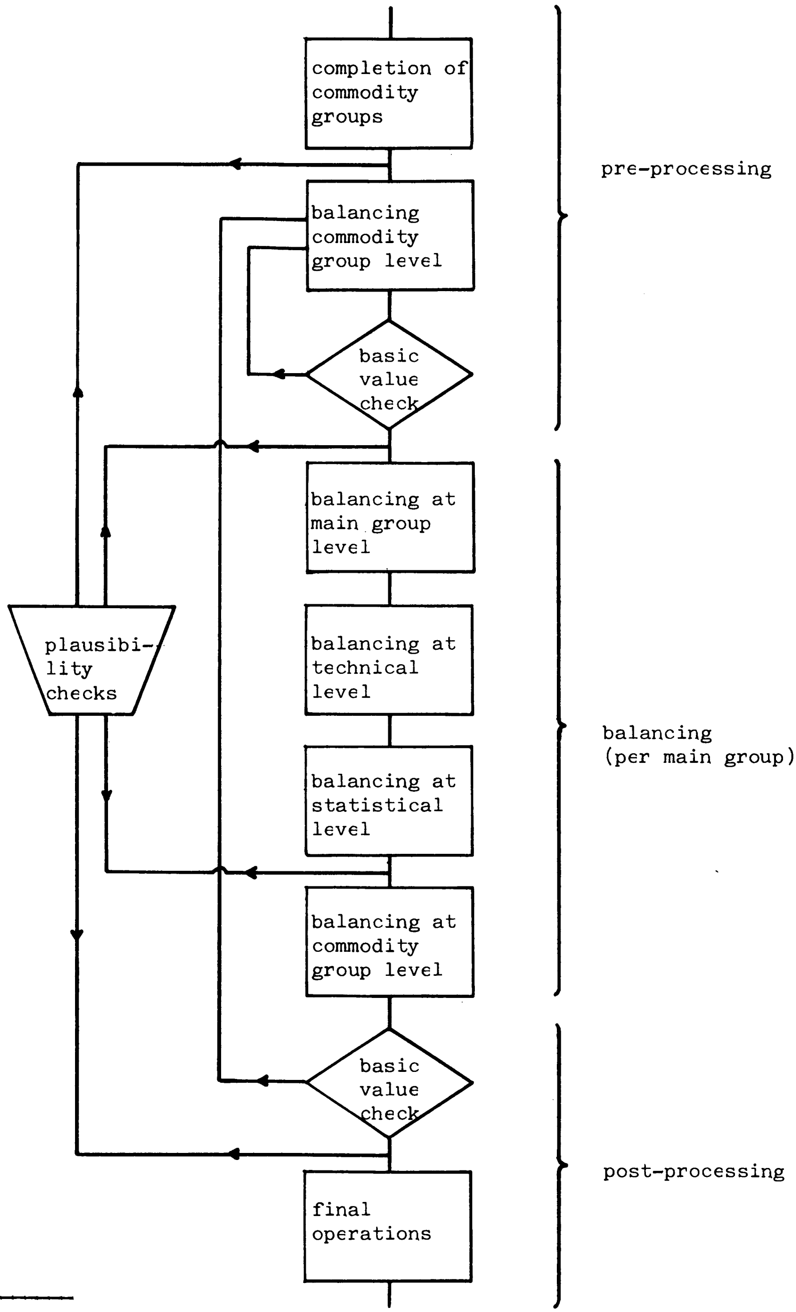
SCHEDULE I

FLOW-CHART OF THE COMPILATION OF THE INPUT-OUTPUT; YEAR T



SCHEDULE II

THE BALANCING [1)]



1) the frequent use of the tariff- and the code collection during the various phases is not represented.

COMPILATION OF INPUT-OUTPUT TABLES IN NORWAY

By

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CENTRAL BUREAU OF STATISTICS OF NORWAY

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I INTRODUCTION

The first system of Norwegian national accounts was developed during the period 1946-1952 by the Research Department of the Central Bureau of Statistics of Norway (CBS), headed by Dr. Odd Aukrust.[1)] This system - based on the production approach (or commodity flow method) rather than the income-approach - was well suited as a basis for compiling data for input-output tables. As an experiment the first input-output table for Norway was constructed in 1951 for the year 1938.[2)] This table was later revised completely when final national accounts figures became available. The first I-O table with final figures applies to the year 1948 and was published in 1952.[3)]

When the national accounts for 1952 were compiled input-output tables were included as an integral part of the work. This is still the case today in Norway. In fact the commodity flows of the input-output tables in constant and current prices constitute the core of Norwegian national accounting, integrated in both the preliminary and the final accounts. The basic tables are rectangular, commodity x sector (absorption matrix) and sector x commodity (make matrix).

I-O tables have not been published on a regular basis, but are available on magnetic tapes. For some select years square tables and some times inverted matrices, have been prepared and published. National I-O tables for Norway have been published for the years 1948 in CBS (1952), 1947, 1948, 1950, 1954 in CBS (1960), 1950 in CBS (1954), 1948 and 1950 in Thonstad (1959), 1954, 1959 and 1964 in CBS (1968). Square input-output tables by county have been published for the years 1965 in CBS (1970) and rectangular tables for the years 1973 in CBS (1978) and 1976 in CBS (1980). National I-O tables for the years 1968, 1973 and 1978 will be published by the CBS in 1982.

Two conspicuous features of the administrative environment of the work with input-output tables in Norway deserve to be mentioned.

(i) The tables are compiled by the National Accounts Division within the Research Department) of the CBS itself. This implies easy access

1) See Aukrust (1955).
2) See Aukrust and Frisch (1951).
3) See CBS (1952).

to the data, since most of the primary statistics used in the work are collected by the special subject matter divisions within the CBS. Many features of the primary statistics are specially designed for the national accounts, and the needs of the national accounts always count heavily when decisions on collecting new or altering the design of existing primary statistics are made. Being on top of the system of economic statistics the national accounts play a key role in the policy pursued by the Bureau for decades of co-ordinating and integrating all economic statistics in Norway, inter alia, by using joint definitions and classifications.

(ii) In addition to preparing the national accounts the Research Department of the CBS is also responsible for most work on economic models involving input-output relations in Norway. This has had and still has a fruitful influence on both model building and national accounting. Thus the model work has been the cause of numerous alterations in the national accounting and vice versa. It may be mentioned that when the national accounts system was revised in the period 1969-1973 to bring the concepts and classifications in aggreement with the United Nations' new System of National Accounts, the large input-output model MODIS IV was developed simultaneously, and numerous features of the national account system was designed for serving the needs of this model.

Since this is a survey paper and not a manual for compiling the Norwegian input-putput tables, we have gone very little into details in describing the statistical sources and the precise methods for arriving at the actual numbers. Readers interested in more details about Norwegian national accounting are referred to Fløttum (1980) and Fløttum (1981).

The paper concentrates on a summary description of the contemporary methods of compiling input-output tables in Norway. Both the construction of national and multiregional tables are described.

A few points on how the tables are used in economic models are also added. First it is necessary, however, to present briefly the accounting framework of the I-O tables.

II THE ACCOUNTING FRAMEWORK OF THE INPUT-OUTPUT TABLES

The real flows of the Norwegian national accounts represented in a simplified way in diagram 1, encompass the realm of input-output.

In the diagram the main groups of accounts are numbered from 1 to 13 with groups 1-2 for commodity accounts, groups 3-12 for the sector accounts and group 13 as the balancing account, representing primary input as well as final output. In the entries the type of flow is indicated by 'C' for commodity flows, 'N' for non-commodity real transfers, 'P' for primary inputs and 'F' for final outputs. The double subscripts of C's and N's identify the credit (delivering) and debit (receiving) side of the transactions. The single subscripts of P's and F's indicate the sector receiving the primary input or delivering the final output, respectively. All other entries are zero by definition. The primary inputs and final outputs connect the array in diagram 1 (the real sphere) with the outer institutional and financial sphere. The primary inputs is delivered to the production and import sectors, while the final outputs come from consumption sectors, real capital formation sectors and export sectors.

All sectors are balanced in real flows in the sense that commodity plus non-commodity input, in value terms, equals commodity plus non-commodity output for each sector. After accounting for the commodity transactions there is in most sectors one residual non-commodity item required for balancing the sector. This residual takes the form of primary input, final output or non-commodity real transfer. A closer study of diagram 1 will reveal how each of the sector groups is balanced.

The commodity accounts are, of course, balanced for each commodity by total input of commodities being equal to total output of commodities. As the sector accounts are all balanced, as mentioned above, it follows therefore that total primary inputs equal total final outputs.

As seen from diagram 1 the industry production sectors absorb commodities ($C_{1,3}$, and $C_{2,3}$) and generate commodities ($C_{3,1}$). An industry production sector has primary inputs or value added (P_3) consisting of services of labour and capital. Net indirect taxes are also part of the primary inputs which make ut the difference between the value of commodity outputs and commodity inputs.

The various general government production sectors absorb commodities ($C_{1,4}$) for the production of the different categories of government services, like administration, defence, health, education etc. The output of government production sectors consists of two parts. A minor part is commodities (marketed government services) ($C_{4,2}$). The major part, however, is not defined as commodity outputs, but as non-commodity real transfers ($N_{4,8}$). The non-commodity real transfers are transferred from government production sectors to government consumption sectors. A government production sector has an output of non-commodity real transfers and an output of commodities equal to the input of commodities and the sum of primary inputs of labour and capital (P_4).

The import sectors have primary inputs from foreign accounts (P_5) equal to the value of commodity outputs ($C_{5,1}$). The export sectors have final outputs to foreign accounts (F_6) equal to the value of commodity inputs ($C_{1,6}$ and $C_{2,6}$).

The household consumption sectors have final outputs of household consumption (F_7) equal to the value of commodity inputs ($C_{1,7}$ and $C_{2,7}$). The government consumption sectors have final outputs of government consumption (F_8) equal to the value of input of non-commodity real transfers ($N_{4,8}$).

The gross fixed investment sectors absorb commodities ($C_{1,9}$), and total outputs are "transferred" as non-commodity real transfers to the real capital formation sectors ($N_{9,10}$ and $N_{9,11}$). A gross investment sector has outputs of direct real transfers equal to the value of commodity inputs. The real capital formation sectors have final outputs (F_{10} and F_{11}) equal to the value of input of non-commodity real transfers ($N_{9,10}$, $N_{12,10}$ and $N_{9,11}$, respectively). The sectors for net additions to stocks absorb commodities ($C_{1,12}$) and transfer them to a special real capital formation sector, i.e. net additions to stocks which are not distributed on the various industries ($N_{12,10}$).

As mentioned above, diagram 1 gives a rather simplified picture of the real flows in the accounting system. In addition to the types of sectors included in the diagram, there are also a number of notional sectors serving different accounting purposes. One is as transactors of (adjustment) items such as imputed bank service charges, import duties, investment excise taxes and commodity tax refunds, which are used when the gross domestic product is to be calculated by adding up the gross product in the industries. Another is to regroup the supply of such

A SIMPLIFIED DESCRIPTION OF THE REAL FLOWS IN THE NATIONAL ACCOUNTS

Delivering accounts \ Receiving accounts			Commodities: Industry commodities 1	Commodities: Marketed government services 2	Production sectors: Industries 3	Production sectors: General government 4	Import sectors 5	Export sectors 6	Consumption sectors: Households 7	Consumption sectors: General government 8	Gross fixed investment sectors 9	Real capital formation sect.: Industries 10	Real capital formation sect.: General government 11	Increases in stocks (net) 12	Final outputs 13
Commodities	Industry commodity	1			$C_{1,3}$	$C_{1,4}$		$C_{1,6}$	$C_{1,7}$		$C_{1,9}$			$C_{1,12}$	
	Marketed government services	2			$C_{2,3}$			$C_{2,6}$	$C_{2,7}$						
Production sectors	Industries	3	$C_{3,1}$												
	General government	4		$C_{4,2}$						$N_{4,8}$					
Import sectors		5	$C_{5,1}$												
Export sectors		6													F_6
Consumption sectors	Households	7													F_7
	General government	8													F_8
Gross fixed investment sectors		9										$N_{9,10}$	$N_{9,11}$		
Real capital formation sect.	Industries	10													F_{10}
	General government	11													F_{11}
Increases in stocks (net)		12										$N_{12,10}$			
Primary inputs		13			P_3	P_4	P_5								

Diagram 1. Explanation of flow symbols: C = commodity flow, N = non-commodity real flow, P = primary import, and F = final output.

(Source: Bjerkholt and Longva (1979)).

commodities the use of which we are unable to identify in detail. This problem is solved by introducing special distribution sectors each receiving a great number of commdities as input, but delivering only one commodity as output. Each distribution sector might be said to define one output commodity as the given combination of the input commodities, since there is no value added in these sectors. This treatment is, inter alia, introduced for repairs and other unspecified types of intermediate consumption.

The real flows as depicted in diagram 1 constitute a semiclosed subsystem of flows between functional sectors. The primary inputs and the final outputs are the open ends of the system. These accounts form the bridge between the real flow accounts and the income and outlay and capital accounts.

The dimension of the system are: about 1 750 commodity groups, 161 ordinary industrial production sectors, 14 central government production sectors, 8 local government production sectors, 20 importing sectors, 15 exporting sectors, 135 groups of private and final consumption expenditure, 45 groups of government final consumption expenditure, 34 gross fixed investment sectors by type of capital good and 3 sectors for increase in stocks. (Some of these numbers may of course vary slightly over time.)

The production sectors are classified according to kind of economic avtivity based on the Norwegian Standard Industrial Classification which corresponds closely to ISIC. The capital formation sectors (10) represent an aggregation of the production sectors.

The commodity classification for goods is based on the CCCN[1)]. This is because both the foreign trade statistics and the manufacturing statistics are based on this nomenclature. There are more than 5 000 commodity groups in these statistics which are aggregated to about 1 350 commodity groups in our final national accounts. The remaining 400 groups of goods and services, in the final national accounts, are distributed almost equally among goods produced in industries other than mining and manufacturing and different types of services. In an aggregated version of the commodity list close to 360 commodities, designated as main commodities, are specified. The aggregated version is, inter alia, used in the preliminary accounts where detailed work is to be avoided. A main

1) See Customs Co-operation Council (1976).

commodity consists of national accounts commodities having the same principal supplier. The principal supplier of a commodity being the (domestic) sector of production with the greatest output of the commodity in question.

The commodity classification in the national accounts is constructed to accomodate the requirement that one commodity should only be delivered to one category of use and also so that the different goods and services within a commodity have the same trade margin and are subject to the same excise taxes (or tax rates).

III COMPILATION OF NATIONAL INPUT-OUTPUT TABLES

A. Final national accounts

The procedure of constructing input-output tables in current prices for the final Norwegian national accounts to be dealt with in the following paragraphs, may be divided into 6 steps as indicated in diagram 2.

1. Estimating the total supply of each commodity at producers' values excluding the value added tax (VAT)

The supply of commodities is treated in three different ways mainly due to the form in which the primary statistics are made available to the national accounts division.

(i) Imports

The imports (c.i.f.) covered by the CBS' external trade statistics (most of the merchandises) are available on magnetic tape and are fed directly into the computer together with masterfiles for converting the about 5 000 commodity codes (corresponding to the CCCN 7 digit codes) in the external trade statistics to national accounts 4 digit commodity codes. The master files are updated every year.

Data for customs duties and import duties are estimated by the National accounts division on the basis of government accounts on revenue data for these items. Customs duties are distributed on commodities using keys based on customs rates and the foreign trade statistics from a benchmark year. For convenience the customs duties of a commodity are treated as flows in approximate basic values of the commodity in question delivered from a dummy sector which is formally included among the production sectors.

(ii) Manufacturing

The Bureau collects annually data on production and intermediate consumption of commodities (corresponding to the CCCN 7 digit codes) for all large establishments (i.e. establishments with at least 5, in some

GENERAL FLOW—CHART, NATIONAL ACCOUNTS FINAL ESTIMATES

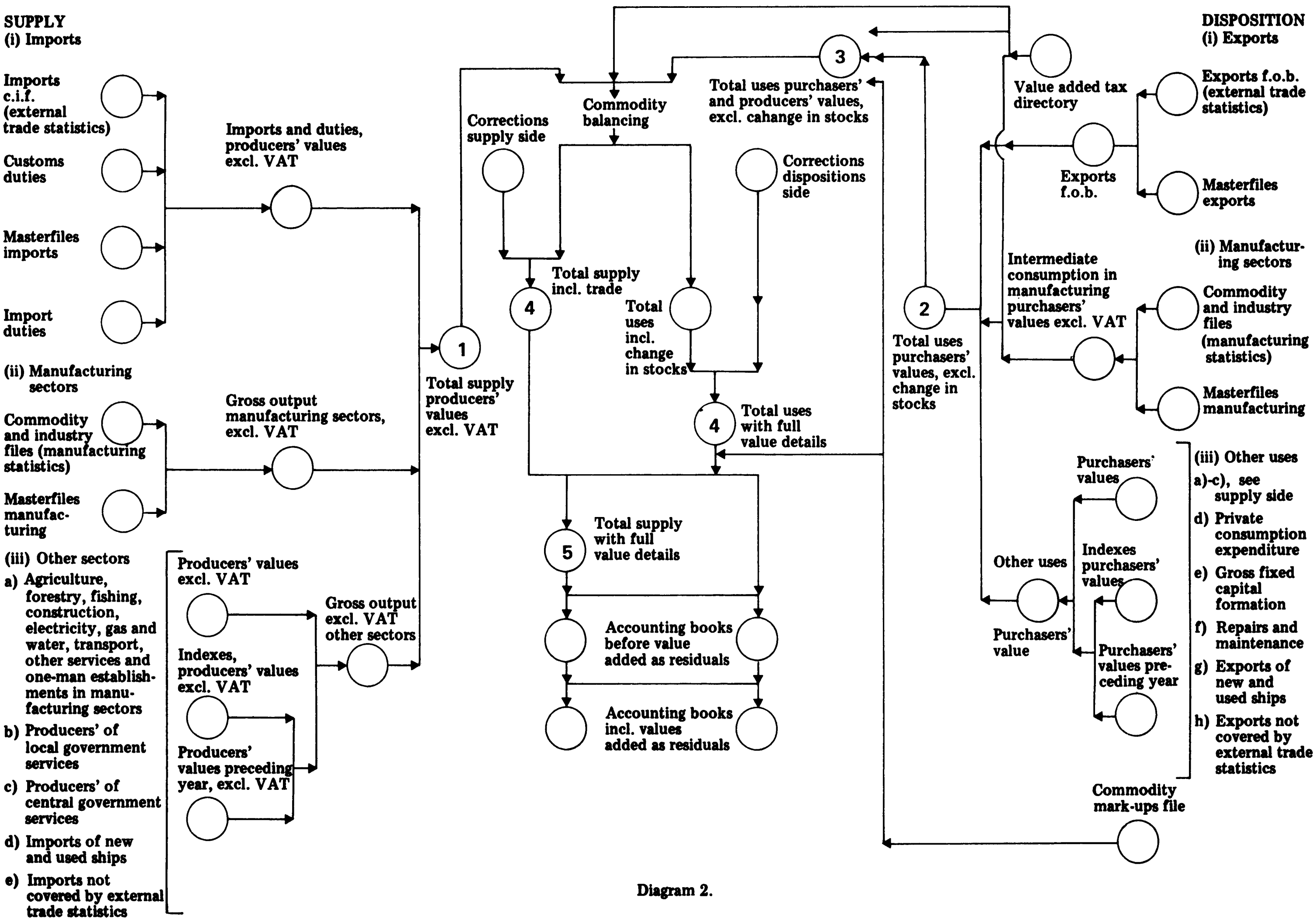

Diagram 2.

cases 3, persons employed) in mining, quarrying and manufacturing industries. Smaller establishments are covered in a more summary way, collecting data only on sales and employment.

Numbers for production and intermediate consumption in the smaller establishments are estimated at the same level of specification as for the large establishments by assuming that these figures are proportional to sales and by using observations from the smaller of the large establishments for computing the proportionality factors. Though one-man establishments are excluded, these annual statistics cover more than 99.5 per cent of the volume of production. This detailed and very reliable statistics are one of the key basic sources of the national accounts and the backbone of the input-output tables. The manufacturing statistics are available on magnetic tapes in a handy format (producers' prices excl. of VAT for outputs, and purchasers' prices excl. of VAT for inputs). The data may therefore be fed directly into the computer together with masterfiles for converting and aggregating the commodity and industry codes in the manufacturing statistics to national accounts requirements. The masterfiles for commodities have to be updated annually.

(iii) Other sectors

The commodity supply neither covered by the external trade statistics nor the manufacturing statistics are estimated by the National Accounts Division from a variety of sources and using different methods of calculation.

For each industrial sector a complete production account is set up specifying the supply and intermediate consumption of each commodity with value added as the balancing element. As indicated in diagram 2 the primary statistics allow direct estimation for some sectors. For other sectors we have to expand figures from a benchmark year applying indexes on figures from the preceding year.

For the general government production sectors the sum of intermediate consumption and value added (consisting only of capital consumption allowances plus wages) defines gross production. The supply of commodities from these sectors, the marketed government services, are very small in relation to production. Gross production in general government minus the value of marketed government services defines public

consumption expenditure, formally treated as a non-commodity real flow transferred to the general government consumption sectors, as outlined in chapter 2.

The external trade statistics cover only merchandises crossing the Norwegian customs frontier. All kinds of import and export of services, merchandises delivered directly to the oil installations in the North Sea or delivered to and used by Norwegians abroad (for instance supplies to Norwegian merchant vessels), fell outside the external trade statistics and must be compiled from other sources.[1)]

Summing ut, we have now estimated the supply of each commodity in producers' prices excl. VAT by each supplying sector (circle 1 in diagram 2).

2. Estimating the total use of each commodity at purchasers' values exclusive of change in stocks

The calculation of the use of each commodity by receiving sector starts out parallell with the procedure followed for arriving at total supply. Exports (f.o.b.) covered by the external trade statistics are fed directly into the computer together with masterfiles converting the commodity codes to the national accounts standards. Likewise data on intermediate consumption (excl. VAT) in the mining, quarrying and manufacturing industries covered by the manufacturing statistics are supplied directly to the computer together with masterfiles converting the commodity and industry codes to the national accounts requirements.

Data on gross fixed capital formation by type of capital good in the industries covered by the manufacturing statistics, are also contained on tapes and are automatically processed applying masterfiles. Other uses are estimated by the National Accounts Division from a variety of sources applying different methods of calculation. Increase in stocks are not determined at this stage.

The value added tax is added to the figures for intermediate consumption by commodity and sector from the manufacturing statistics to arrive at figures in purchasers' values. Information on the value added tax are stored in a separate value added tax directory, showing for each

1) Exports and imports of ships are covered by the external trade statistics, but are, due to special treatment, included among other sectors in diagram 2.

commodity and category of use whether VAT accrues and the tax rate. (The tax rate may be different from the statutory 20 per cent mark up in cases where only part of a commodity and/or use is subject to VAT). The VAT directory is kept continually updated for changes in coverage and rates.

Summing up, we have now estimated the use of each commodity in purchasers' prices by receiving sector, except changes in stocks (circle 2 in diagram 2).

3. Decomposing the uses of each commodity in separate value flows

The commodity flows in purchasers' values are split in eight different value flows; approximate basic value - production and import, value added tax - production and import, excise taxes - production and import, subsidies - production and import, approximate basic values - trade and transport margins, value added tax - trade, excise taxes - trade and subsidies - trade. The first four components comprise the commodity flows in producers' prices while the last four constitute the gross trade and transport margins. The decomposistion is performed in the computer by means of a commodity mark-ups file, containing for each commodity and receiving sector (the distributional keys for) each value component's share of the purchasers' value. The mark-ups are last year's relative figures updated with any new information on tax changes, changes in profits and/or transport margins from special surveys etc.

The quality of the mark-ups is a weak spot in the national accounts. The trade sector is particularly badly covered by basic statistics. It has not been possible to distinguish between wholesale and retail trade in the national accounts, nor has it been possible to divide the trade sector into subsectors according to types of goods marketed.

It should be emphasized that the Norwegian practice of an extensive decomposition of the commodity flows into components involves a gross treatment of all excise taxes and subsidies, including the value added tax. Most countries resorting to a VAT system have chosen some kind of net treatment of VAT in their I-O tables. Norway is of course able to report I-O tables with a net treatment of VAT, simply by adding up from gross to net. A gross treatment of VAT has the advantage that gross product in each industry at sellers' or purchasers' prices including accrued VAT net, may be computed in a straightforward manner.

This is not always easy to do when some sort of net treatment of VAT is applied, especially for industries where only some of the input and/or output flows are subject to VAT.

4. Commodity balancing

In step 1 we calculated the supply of each commodity at producers' values excl. VAT. The value added tax on production and import calculated from the user side (in step 3) is at this stage distributed among suppliers according to their market shares in producers' values excluding VAT. Gross output in wholesale and retail trade distributed by commodity is determined from the gross trade margins on the user side.

Based on figures for supply and uses in producers' values, preliminary estimates for increase in stocks are computed as the difference between the supply and use of each commodity. Supply, uses and increase in stocks for each value flow of each commodity are checked and adjusted, a process normally requiring 2-3 man-months. The commodity balancing is first carried out at the detailed level and then aggregated to main commodities. We seldom make final adjustments directly on the aggregates and distribute the necessary adjustments at the detailed level by applying fixed keys. When confronting the initial supply and demand estimates, we use principles and procedures such as:

(a) The preliminary figures for changes in stocks are considered and checked against the available primary statistics such as the annual manufacturing statistics and the statistics on stocks based on data collected from large manufactures and wholesalers.

(b) Changes in stocks for services are eliminated.

(c) Some food products (fresh fish, milk, vegetables etc.) can be stored only for a short time and thus may have relative small changes in stocks.

(d) The trade margins are sometimes adjusted in the accounts as a matter of necessity.

(e) Total intermediate input to each production sector is regarded as a reliable number, but the distribution on commodities might be adjusted.

(f) Corrections on the supply- or user-side of the commodity balance, except direct correction on changes in stocks, are fed manually into the computer, whereas the computer compiles changes in stocks.

All the current value flows of the 1 750 commodities of the national accounts are fully balanced.

No separate discrepancy items are shown. The balance between supplies and all categories of demand of a commodity is due to increase in stocks and statistical errors. Because of incomplete coverage of our statistics on stocks we are unable to distinguish between changes in stocks and statistical errors in the published estimates. Besides the increase in stocks, the trade margins are the most questionable estimates of importance in the commodity balancing. The producers' values on the demand side are constructed by deducting the trade margins from the purchasers' values. Errors in the increase in stocks are to a large extent due to errors in the estimates of the trade margins, since the first approximation for increase in stocks are the difference between supply and use of each commodity at producers' values, as described in the preceding section.

5. Decomposing the supply figures

Based on the decomposed and adjusted figures for uses, decomposed values are also computed for the supply side. The allocation of indirect taxes and subsidies for each commodity among the various production sectors and imports, primarily occurs on the basis of each supplier's share of the total supply of each commodity. The basic value is determined residually. Gross output in wholesale and retail trade is also decomposed in accordance with the decomposed and adjusted figures on uses.

6. Balancing the ledgers (the accounting books)

Values added are obtained as the residual items when the accounts for production (and imports, private final consumption expenditure, government final consumption expenditure, gross capital formation and exports) are balanced. The listing of the detailed figures in the sector-commodity and commodity-sector matrices is referred to as the ledgers of the national accounts. They comprise virtually the entire production, consumption expenditure and capital formation accounts (except the components

of value added). The ledgers contain information on gross output and intermediate consumption of each commodity by production sector, value added by production sector, gross domestic product, private final consumption expenditure by commodity and sector, central and local government consumption expenditure by sector (for purpose), gross fixed capital formation by commodity and type of capital good as well as by type of capital good and capital formation sector, increase in stocks by commodity and imports and exports by commodity.

The detailed ledgers appear formally as eight pairs of rectangular input-output tables; each pair corresponding to one of the eight different value flows in purchasers' values. A pair of tables consist of a commodity x sector absorption matrix and a sector x commodity make matrix. One pair of tables will be in approximate basic values. Tables in producers' or purchasers' values are obtained simply by adding the appropriate basic tables. In addition to the detailed ledgers the ledgers specifying commodity flows in producers' values and gross trade and transport margins are part of the standard pointout.

The value added by production sector resulting from balancing the ledgers, is divided into components in a separate process not shown in diagram 2. Compensation of employees, consumption of fixed capital, indirect taxes and subsidies are compiled independently. Operating surplus is calculated as the difference between the total value added and the independently compiled components.

The reason for choosing stockbuilding and operating surplus as balancing items in the I-O tables (and in the national accounts) are to a great extent due to the unsatisfactory basic statistics available for these items.

B. Preliminary accounts

The final annual national accounts are usually prepared in the period May - October, two years after the computational year (t). Mainly to satisfy the need for economic-political decision making, three versions of preliminary national accounts are estimated - with increasing degree of reliability. The first - the December accounts - are prepared in November and December in year t on the basis of current statistics for

the first 9-10 months of the year. The second - the March accounts - are prepared in February - April in year t+1 on the basis of current statistics for the whole year. The third - the November accounts - are prepared in September - November in year t+1. Only the second and the third accounts contain complete integrated input-output tables.

With some modifications the basic procedure for compiling preliminary national accounts is the same as for the final accounts depicted in diagram 2. The basic statistics are of course different, because as indicated above, much of the statistics used in the final accounts are not available for the preliminary accounts. Indexes have to be applied more extensively in the preliminary accounts, usually to develope totals. Relative shares from the last final accounts are used to distribute the totals on the detailed commodity flows. For instance for the mining, quarrying and manufacturing industries a production index is used to calculate the totals in the December and March accounts while sum figures (but not the specification on commodities) are available from the manufacturing statistics for the November accounts. This implies that the basic input-output pattern from the last available final accounts is used in the preliminary national accounts.

A distinctive feature of the preliminary I-O tables in the December and March accounts is that these tables are first worked out in the prices of year t-1 and then inflated to current prices. This has proved convenient because (Laspeyre's) quantity indexes are used extensively in the calculations.

C. Deflation

The calculation in constant prices is done by first, for each sector dividing the supply and use of each commodity (valued in approximate basic values - production and import) by an appropriate price index. The price index varies with the type of sector. For imports and exports price indexes from the external trade statistics are used. For domestic production a special index prepared by the Division for manufacturing and trade statistics in the CBS is used. Domestic use in constant prices is calculated as import plus domestic production minus export.

Usual index techniques are employed such as applying price indexes for representative commodities in those cases where indexes for a commodity

cannot be constructed. For some commodities the indexes are constructed on the basis of the indexes for the input used in the production of the commodities in question. In some cases volume indexes are first constructed and the price indexes calculated implisitly.

A general problem with most of the price indexes is that they are not measuring what we should want them to. They are not indexes for the approximate basic prices, but for producers' prices excl. VAT, purchasers' prices, f.o.b. prices or c.i.f. prices. They might even be calculated according to Laspeyre's formula. Most of these serious problems are very difficult to do anything about with the limitations set by our present resources.

Commodity flows in other values than approximate basic values - production and import - are achieved by applying the mark-ups from the base year on the approximate basic values for the current year. Output from the trade sector at approximate basic values distributed by commodity is determined in accordance with the figures for uses. The other value components of the trade sector production are compiled by applying the base year mark-ups. Since the domestic use is determined residually the I-O tables in approximate basic values are automatically fully balanced. Bacause of shifts in the supply and demand pattern, the flows in the other value components will normally not be in balance. A special sector named "price gains in fixed prices" has been introduced to absorb the margins between total supply and total demand in fixed prices for the value components other than approximate basic values.

IV REGIONAL INPUT-OUTPUT TABLES

The first construction of a complete set of multi-regional accounts was worked out by the Central Bureau of Statistics for the year 1965, see CBS (1970) and Sevaldson (1973). A renewed effort was made for the years 1973 and 1976, see CBS (1978), CBS (1980) and Hvidsten and Larsen (1979). The next year for which regional accounts will be prepared will probably be 1980.

The major difference between the multi-regional accounts for 1965 and those for 1973 and 1976 is that the accounts for 1965 were constructed within a traditional industry-by-industry framework while the accounts for 1973 and 1976 were constructed in accordance with the present SNA and thus based on a commodity-by-industry framework.

The regional units used in all accounts were counties. Complete accounts for all the 19 counties in Norway were prepared. In addition a dummy county has been introduced to which undistributed supply and use of goods and services were allocated. (We shall later return to the nature of the undistributed flows.) The counties of Norway are traditional administrative units which do not always coincide with natural economic borderlines. A convincing reason for choosing counties as regional units in the accounts is, however, that over the last two decades the role of the counties has become increasingly important in the overall economic planning. Of course, the regional breakdown of national totals was made considerably easier by relying on existing administrative units well represented in much of the primary statistics.

The regional I-O tables give a breakdown of the commodity flows in the final national accounts at market prices only. There is no separation of the commodity flows into value components. Inputs are measured at purchasers' prices and outputs at producers' prices; output of the trade sector being the trade and transport margins.

The calculations were performed on the most detailed level of production sectors in the national accounts while the commodities were aggregated to about 300 groups. Though it was found convenient to calculate in a disaggregated manner, the regional tables published in CBS (1978) and CBS (1980) were aggregated to 23 industry sectors, partly to increase reliability of the regional estimates, partly to avoid problems of confidentiality and partly from an assessment of user needs.

The total value added by production sector and county estimated by balancing the regional I-O tables was divided into components. Compensation of employees, consumption of fixed capital, indirect taxes and subsidies were compiled separately; operating surplus being the balancing item.

Estimates for supply from own production and for use in intermediate consumption, private final consumption expenditure, governemnt final consumption expenditure and gross fixed capital formation for most categories of goods and services were compiled by county. It has, however, not been possible to subdivide exports, imports and changes in stocks by county. Nor has it proved possible to estimate figures by county for the following industries: ocean transport, carriage by rail, air transport, oil activities in the North Sea, coal mining in Svalbard and telecommunications. The undistributed part of supply and use of goods and services were allocated to the dummy county (to ensure that the county subtotals add up to the national totals). For each commodity within each county there will be either a surplus or a deficit of supply over disposition. A surplus of a commodity in a county means that the county's supply of commodities to stocks, undistributed industries or to exports to foreign countries or other counties, exceeds the county's receipt of the same commodity from other counties including the extra county.

This implies that the I-O tables do not show the gross commodity flows between the counties, but only the net flows. Except for some services, it is extremely difficult to classify the county of origin for a particular commodity used in a county, or the receiving county for a particular commodity produced in a given county. Thus the I-O tables constructed are multiregional rather than interregional, in the sense that regional interactions are noe explicitly revealed. The accounts do for instance not display any information about flows of goods and services between any pair of counties.

Different types of indicators were used to allocate commodity flows to regions. The indicators correspond as far as possible to the commodity flows they were used as indicators for. Thus in many cases the indicators are (nearly) identical with the commodity flows themselves. For example the production and intermediate consumption in the manufacturing industries by county were obtained simply by aggregating by county the information provided by the establishments reporting to the manufacturing statistics. When quantity indicators are used to subdivide the flows,

distribution biases will occur if there are different prices between counties. Biases will usually also occur when the number of employees is used as an indicator.

The indicators were used to construct vectors containing the counties' shares of the totals. These vectors were multiplied by national accounts totals to obtain corresponding numbers for counties.

A schematic outline of the regional I-O tables are given in tables 1 and 2. In table 1 the import column will only have figures in the dummy county. Gross output of a production sector is measured at producers' values. The trade margin of each commodity group appears as production in the wholesale and retail sector. Thus the sum column in the supply table shows the supply of commodities from units resident in the county measured in purchasers' values.

The figures in table 2 are measured in purchasers' values. The column for surplus/deficit shows the difference between supply and disposition of the commodities in the county and may be interpreted as the net export values of the commodities. These values will of course be influenced by the use of the constructed county and will also include all kinds of biases in supply and disposition.

Table 1. Supply of commodities by county/main region

Commdity group	Production sector 1,2, 3, ... m	Import	Total
Commodity group 1			
" " 2			
:			
:			
:			
Commodity group n			
Total			

Table 2. Components of value added and disposition of commodities by county/main region

Commodity group	Production sector 1,2, 3, ... m	Final use	Surplus deficit	Total
Commodity group 1				
:				
:				
:				
Commodity group n				
Value added				
- Compensation of employees				
- Operating surplus				
- Depreciation				
- Indirect taxes				
- Subsidies				
Total				

V USE OF INPUT-OUTPUT TABLES IN ECONOMIC MODELS

When input-output relations are used in models for economic planning and analyses in Norway the model builders always start with the rectangular input-output tables of the national accounts and not from a traditional Leontief square (industry by industry or commodity by commodity) I-O table prepared by the National Accounts Division of the Central Bureau of Statistics of Norway. Thus the elimination of the degrees of freedom stemming from the fact that more than one industry produce a certain commodity is considered as part of the model formulation and not as a data constraint given from the outset. For some problems a commodity-by-commodity table may be more adequate than an industry-by-industry table and vice versa. For instance a commodity-by-commodity table may be the best choice for analyzing the repercussions of a change in final demand on intermediate demand, while an industry-by-industry table may be preferred for price analyses since the crucial links in price relations are between primary costs (known from the statistical data by industry and not by commodity) and intermediate input costs. Starting closer to the observations, as using rectangular I-O tables rather than square tables involves, enables the model builder to design the input-output relationships better for the purpose of the model in question.

Thus the I-O tables used in different models differ not only with respect to level of aggregation, but also with respect to assumptions made to arrive at invertable I-O matrixes, because the models serve different purposes.

Since all the value components of a commodity flow distinguished by the national accounts are represented in the I-O tables, the model builder also have a choice between I-O tables in different value sets; e.g. approximate basic values, producers' values and purchasers' values.

Three models may be mentioned briefly to illustrate the use of the I-O tables in Norway. REGION is a traditional static multiregional I-O model using the regional I-O table as the main data source. The model has been used for decomposing national forecasts for employment, population and industrial development by county and for analyzing the use of natural resources.[1)]

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1) For a description of the model, see Skoglund (1980).

MSG-4E (Multi-Sectoral-Growth Model version 4 Energy) may be described as a long term growth model built around an I-O core. The main task of MSG-4E is macro economic analyses in the long run (15-20 years) with emphasis on energy questions. The I-O matrix is rectangular (the number of commodities are greater than the number of sectors) allowing multi-product output in the production sectors. The ratio between output and total intermediate demand (the commodity productivity) may be changed from period to period in a computational sequence and there is price dependent substitution possibilities between energy commodities and the sum of other material input.[1)]

MODIS IV (MOdel of DISaggregated type version IV) is the main quantitative tool for macroeconomic planning in the short to medium run (1-5 years) in Norway. The model is extensively used by the Ministry of Finance and the Government Secretariat for Long Term Planning and Co-ordination for a variety of economic policy analyses and planning purposes.[2)] The model is the most refined and detailed user of the national accounts data and was, as mentioned in the introduction, developed simultaneously with the conversion of the national accounts to the new SNA. The core of MODIS is a large rectangular I-O matrix based on commodity flows at approximate basic values.

The main points in the process of estimating the input-output structure of MODIS IV is given in an appendix to this paper.

Because of the heavy claims the administrative use puts on MODIS most of the coefficients of the model are re-estimated every year. The main data base for the model is the latest available March accounts. The updating of the model structure can be regarded as an extension of preparing the March accounts and is to some extent done by the same people. In fact this model is the main, not to say the sole, reason for preparing complete I-O tables in the March accounts.[3)]

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1) The MSG models are described in several publications. Johansen (1979), Lorentsen and Skoglund (1976) and Longva, Lorentsen and Olsen (1980) are specially recommended.
2) In 1980 these institutions used the model more than 30 times, each computational round involving a number of years and alternatives.
3) MODIS IV is documented in more than 40 publications describing different aspects of the use and construction of the model. English readers interested in MODIS IV are referred to Bjerkholt and Longva (1980), Bjerkholt and Longva (1975) and Furunes (1975).

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Appendix

ESTIMATION OF INPUT-OUTPUT COEFFICIENTS OF PRODUCTION IN THE MODEL MODIS IV*

The three central concepts of the input-output framework of MODIS IV are commodity, sector and activity. These concepts distinguish between three different aspects of absorption and generation of goods and services, namely what is absorbed or generated (the commodity concept), where the absorption or generation is taking place (the sector concept), and how the goods and services are absorbed or generated (the activity concept).

The number of commodities of the model, which are aggregates of the commodities of the national accounts, is about 200. Nearly 190 of these are industry commodities while 10 are marketed government services.

A sector may generate commodities or absorb commodities, or both. The most important group of sectors are the industries which, together with the general government production units, form the production sectors. The production sectors transform input flows of commodities into output flows of commodities and thereby absorb some commodities while generating others. The other main sector groups, which either generate or absorb commodities, are the import sectors, export sectors, the household consumption sectors and the gross investment sectors.

By activity is meant a subdivision of a sector according to characteristic properties of the type of commodity generation, absorption or transformation which are taking place. The subdivision of sectors into activities carries a different meaning for each type of sector. The commodity flows between activities include all generation and absorption of commodities except changes in stocks. Within each activity there are assumed fixed proportions between commodity inputs and commodity outputs.

The main purpose of subdividing sectors into activities is to avoid having to assume fixed proportions between commodity inputs and commodity outputs for the sector as a whole. The subdivision also makes it

* The following exposition focus only on main points in the estimation process and draws heavily on Bjerkholt and Longva (1979), Appendix 1. A Much more complete and detailed presentation is given in Furunes and Longva (1976). The basic ideas were first presented in Bjerkholt and Longva (1970).

possible to distinguish between different ways of generating or absorbing a certain commodity within the same sector.

To describe the commodity-by-sector flows of the economy we introduce the following definitions and balance equations:

S_{ij}^{+} = output of commodity i from sector j

S_{ij}^{-} = input of commodity i to sector j

S_j = net output of commodities in sector j = sector level of sector j.

(1) $$S_j = \sum_i S_{ij}^{+} - \sum_i S_{ij}^{-}$$

X_i = net addition to stocks of commodity i

(2) $$X_i = \sum_j S_{ij}^{+} - \sum_j S_{ij}^{-}$$

Balance equations similar to those given for the sectors in equations (1) and (2) will also hold for commodity flows into and out of activities:

A_{ij}^{+} = output of commodity i from activity j

A_{ij}^{-} = input of commodity i to activity j

A_j = net output of commodities in activity j = activity level of activity j.

(3) $$A_j = \sum_i A_{ij}^{+} - \sum_i A_{ij}^{-}$$

(4) $$X_i = \sum_j A_{ij}^{+} - \sum_j A_{ij}^{-}$$

By the concepts of sector and activity levels introduced above is meant a measure of the net commodity generation or absorption that take place in a sector or an activity, respectively. The values of the activity levels within each sector add up to the sector level. The activity levels for the import activities are non-negative and the activity levels for domestic final demand and exports are non-positive by definition. The import activities have no commodity input while the final

demand activities have no commodity output. The activity levels of a production activity may be interpreted as the gross product of the activity and is usually positive.

The basic quantity equation of the input-output framework is

$$(5) \qquad \Lambda A = X,$$

where $\Lambda = \{\lambda_{ij}\}$ is a commodity-by-activity coefficient matrix in which the element $\lambda_{ij} = (A^{+}_{ij} - A^{-}_{ij})/A_j$ (positive or negative) gives net output of commodity i per unit of activity level j.
A is a vector of activity levels, and
X is a vector of net additions to stocks (by commodity).

Equation (5) follows directly from manipulations of (4) by inserting the expression for λ_{ij}.

The basic assumption of the quantity input-output model of MODIS IV is that the quantity of commodity inputs to and outputs from an activity are related by fixed proportions, i.e. that all elements in Λ are constants.

The activity coefficients are estimated from the base year of the model. In the following we will present the main points in the estimation of the coefficients for the production activities which is less straightforward than estimating the rest of the activity coefficients. We let subscript P denote the production activities and introduce the following notation for base year flows:

W^{+}_{A} = activity output matrix with typical element A^{+}_{ij}.

W^{-}_{A} = activity input matrix with typical element A^{-}_{ij}.

The industry activity coefficients are estimated by:

$$(6) \qquad \Lambda_P = (W^{+}_{AP} - W^{-}_{AP})\, \hat{A}_P^{-1} ,$$

where $\hat{A}_P$ denotes a diagonal matrix with the levels of the production activities in the main diagonal.

As seen from (6) the production structure of a given activity is described by (i) <u>the output structure</u>, i.e. the commodity output

composition, (ii) the input structure, i.e. the commodity input composition, and (iii) the commodity productivity, i.e. the proportion between total commodity output and total commodity input.

The elements of the W^+_{AP} and W^-_{AP} matrices are in general not directly observable. The activities can be regarded as macro processes aggregated across establishments within the same industry (production sector). Establishment is the unit of observation in the production part of the national accounts. When there are more than one activity in a sector the subdivision thus imply a problem of estimation from observable data.

The data source used in the estimation of the activity input and output matrices for the base year is the corresponding commodity-by-industry matrices.

W^+_S = sector output matrix with typical element S^+_{ij}.

W^-_S = sector input matrix with typical element S^-_{ij}.

The connections between sectors and activities may be described by an aggregation matrix Z whose typical element z_{ij} equals one if activity j belongs to sector i and zero otherwise. (Since a specific activity belongs to only one sector, there is only one element different from zero in each column of Z.)

By definition we have:

$$W^+_{SP} = W^+_{AP} Z'_P \tag{7}$$

$$W^-_{SP} = W^-_{AP} Z'_P \tag{8}$$

At the chosen level of industry and commodity aggregation the same commodity can be, and often will be, produced in more than one sector and each sector will normally have more than one commodity output. The problem we are facing is thus to allocate the commodity inputs and outputs of each industry between the different activities specified within each industry. The derivation of the activity input and output matrices from the corresponding ones for sectors starts with an a priori specification of the distribution of sector outputs among activities, i.e. with a specification of the elements of A^+_{AP}. This procedure is tantamount to a definition of the activities of the model.

It is assumed that most commodity outputs from a sector are produced with separate production functions, e.g. non-jointly. The main principle followed in subdividing a sector into activities is therefore to let each important output commodity be produced in a separate activity. Minor output commodities, if any, are lumped together and included as joint products in the activity with the biggest share of total output of the sector. This a priori allocation of all commodity outputs in each sector between activities gives us elements of A^{+}_{AP} and Z_P automatically fulfilling the restriction (7).

In distributing commodity inputs of a sector among its activities we use equation (8) as the starting point. Equation (8) says that the content of the columns of W^{-}_{AP} is to be determined in such a way that the sum over all activities in a sector equals total sector input of each commodity. With n_A activities and n_S sectors of production (8) gives us thereby n_S independent equation between the n_A unknown columns of W^{-}_{AP}. Equation (8) has thus $n_A - n_S$ degrees of freedom, i.e. so many as the excess of the number of activities over the number of sectors.

The degrees of freedom can be eliminated by imposing additional restrictions between the activity columns of W^{-}_{AP}. An especially simple approach is to assume that all activities in the same sector have identical input structure and commodity productivity. This implies a general assumption of what we later shall refer to as sector technology.

Another possibility will be to assume that all activities with the same (main) output commodity have identical input structure and commodity productivity. This is straightforward if the number of commodities equals the number of sectors. However, if there are more commodities than sectors, as is the case in MODIS IV, this pure commodity technology approach must be modified for instance by assuming that all activities with output commodities which have the same sector as main supplier have identical input structure, i.e. a kind of sector technology. Such a mix of sector and commodity technology assumptions, is used in the present version of MODIS IV in estimating the elements of W^{-}_{AP}.

It is important to note that, as long as the degrees of freedom of (8) are eliminated by assumption of linear relationships between the input structures and commodity productivities of the various activities, the matrix W^{-}_{AP} will at most have so many linearly independent columns as there are sectors. This is just a reflection of the fact that W^{+}_{SP} and W^{-}_{SP} contain all our empirical information about the production structure in the base year of the model, i.e. about the available technologies.

The formal estimation procedure followed in MODIS IV starts out with a grouping of the n_A activities in n_S groups and by assuming that the input structure and commodity productivity are identical for all activities within the same group. This can be done by selecting a main activity in each group (for instance the one with the largest output) and linking the other activities in the group by proportionality to the main activity. The chosen procedure is, however, more symmetric with regard to the partaking activities. For purpose of exposition we introduce an auxilliary matrix T (which is eliminated before the actual computation takes place) of dimension equal to the number of commodities times the number of sectors. The typical element of T, t_{ij}, represents total input of commodity i into those activities that form group j. The matrix T may then be interpreted as the input matrix for a set of "macro" activities, each macro activity consisting of all activities with identical input structure and commodity productivity.

Each activity input vector, i.e. each column of W_{AP}^-, is now related to the column of T corresponding to the activity group it belongs to by the following equation:

(9) $$W_{AP}^- = T\theta$$

The elements on each row of θ allocate the input vector of the corresponding "macro" activity between the activities belonging to the activity group. All activities with non-zero elements on the same row belong to the same group, and activities within such a group will have identical input structure if there is one and only one element in each column of θ. With the interpretation of T given above the proportions between the elements different from zero on the same row of θ must be set equal to the proportions between the total commodity inputs of the activities in the group. These activities will have identical commodity productivities i.e. identical proportions between total commodity output and input, if the ratios between the elements on each row of θ are proportional to the ratios between total commodity outputs[1)].

1) It is possible to eliminate the degrees of freedom of (8) without assuming that the input structures and commodity productivities are identical for all activities within the same group. This can be done by allowing for more than one element in each column of θ. The columns of T may then be interpreted as proportional to the input structures in a set of n_S different technologies available in the base year of the model. The elements of θ then determine the input structure and the commodity productivity of each activity by combining these input technologies and by relating them to the commodity output in the way desired.

As can be seen from equation (10) below, the normalization of the rows of θ is irrelevant for the computation of the elements of W^-_{AP}, it is only the ratios between the elements that count. The question of normalization is thus a question of convenience, althoug the actual interpretation of T will change. T is, however, only a matrix of additional variables without any separate interest. In the actual specification of θ in MODIS IV the elements on the same row are set equal to total commodity output of each activity belonging to the group. The total outputs are known from W^+_A.

When the elements of W^-_{SP}, Z_P and θ are given (8) and (9) impose $n_S + n_A$ equations between the $n_S + n_A$ unknown columns of T and W^-_A. The explicit solution in respect of W_{SP}, θ and Z_P using (8) and (9) is

$$(10) \qquad W^-_{AP} = W^-_{SP}(\theta Z'_P)^{-1}\theta$$

For this system to be uniquely determined it is required that $(\theta Z'_P)$ is a non-singular matrix. The non-singularity condition will depend upon the actual content given to θ, singularity normally indicating a faulty logic in the specification.

The model specifies about 200 industry production activities. About 20 of these are assumed to have no commodity input and for 10, mostly covering oil and shipping, the input and productivity structure are based upon exogenous information, such as engineering data etc. The rest, about 170, are grouped in about 125 groups of activities with different input and productivity structures, i.e. equal to the number of industry production sectors.

It is possible to distinguish between two main categories of activity groups in the specification of the elements of the 125 columns of θ, namely groups with commodity technology and groups with sector (industry) technology.

In a commodity technology group all activities have the same main output commodity. All the activities have the same input and productivity structure irrespective of which sectors the activities belong to. We are here assuming that the commodity is produced by a characteristic technology.

In a sector technology group all activities belong to the same sector. All the activities have the same input and productivity structure

irrespective of which commodities the activities produce. We are here assuming that different commodities are produced by the same technology, and that the same commodity produced in different sectors are produced by different technologies.

In the present version of MODIS IV the assumption of commodity technology is, with few exceptions, made whenever possible, i.e. we have normally grouped together activities with the same main output commodity. Altogether we have formed more than 20 such groups, covering about 50 activities.

Many commodities are the main product in only one activity and about 80 of these activities form an activity group each. It is a matter of terminology whether to characterize each of these "groups" as having a sector or a commodity technology.

For the rest, nearly 25 groups covering about 50 activities, the assumption of sector technology is made, often more out of necessity due to the data sources available than due to a belief in the correctness of the assumption made. In most cases the output commodities of the activities within such a group have the same sector as main producer. Normally this means that no other activities have these commodities as their main output. All information we have about the input and productivity structure is then limited to the sector they belong to. However, this does not mean that the input and productivity structures of these activities are always identical to that of the sector they belong to, because in many cases there are other activities in the sector for which we have assumed commodity technology.

TECHNIQUES IN THE COMPILATION OF DANISH INPUT-OUTPUT TABLES: A NEW APPROACH TO THE TREATMENT OF IMPORTS.

Bent Thage
Danmarks Statistik

Introduction:

National accounts work in Denmark has since its initiation in the 1930s been closely connected with the construction of input-output tables, and the commodity-flow method - or production statistical method - has been the core of the technique.

Input-output tables for Denmark have been published for the years 1930-39 (DSD 1948), 1946 (DSD 1951), 1947 and 1949 (DSD 1955). 1953 (DSD 1962) and 1966 (DS 1973) at still higher levels of detail and sophistication. A summary of the early Danish experiences is given in Bjerke, Milhøj and Nørregaard Rasmussen (1956).

The interruption between 1953 and 1966 was caused by a general slow-down of national accounts activity in this period and the 1966 table symbolized a revival of the work as a response to a still increasing demand for more detailed and reliable national accounts figures. Since 1966 annual input-output tables have been worked out. At the moment the time series of tables cover the years 1966-78 on a comparable basis.

Compared with the earlier tables the 1966 table represented a new generation of input-output tables, partly by its size (130 industries), and partly by being worked out according to precisely defined techniques, namely as an industry-industry table on the assumption of an industry technology in the terminology of new SNA (UN 1968). The 1966 table was completed in 1972 and published in 1973, and over the next 4-5 years comparable tables for 1967-75 were compiled. The tables for 1966-75 were available at both current prices and constant 1970 prices. For practical reasons they were however not published but made available in a data bank, and have been used extensively for analytical purposes in recent years.

This paper gives a brief description of the commodity-flow system on which the input-output tables are based and of the techniques first used for constructing the tables for 1966-75. Its main contents are however the description of a modified technique by means of which all the tables for 1966-75 have been recalculated and the tables after 1975 constructed.

The modified technique is still following the SNA recommended procedure, but it differs from the methods first used in the construction of the 1966-1975 tables especially concerning the degree of disaggre-

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gation of the two basic matrices (the make matrix and the absorption matrix), and the treatment of imports. The basic matrices are now rectangular and contain about 1600 commodities. The treatment of imports, which is a very important question in input-output tables for countries with a high rate of foreign trade, has been modified to make the table more flexible for different analytical purposes. In this connection the difficult question of distinguishing between competitive and non-competitive (complementary) imports which is particularly difficult to handle in time series of input-output tables has been solved in a rather untraditional way.

The commodity-flow system:

In Denmark there is, as proposed in new SNA, a complete integration between national accounts and the detailed commodity and production accounts which form the basis for the input-output tables. The final yearly national accounts contain about 4000 commodity accounts and 121 production accounts inclusive of four artificial production accounts, three of which are redistribution accounts and one contains imputed bank service charges. There are 78 categories of final use, of which private consumption represents 66 categories. The complete system is thus made up of a 4000 x 121 matrix for supply and a 4000 x 199 matrix for use. In the latter matrix each element is further subdivided into element for basic value, wholesale trade margin, retail trade margin and commodity taxes, net. The total number of elements in the commodity-flow system is therefore about 3.5 million (inclusive of empty cells).

The calculation at constant prices takes place also at this level of detail, i.e. price indices for imports and for domestic production, respectively, are determined (mainly from wholesale price material) and the uses at constant prices are calculated roughly on the assumption that exports are made up of domestic output, and all other uses have identical import contents.

Most of the figures published for the final national accounts are obtained by aggretations in this datasystem, but of course figures on income distribution, other indirect taxes etc. must be calculated separately outside the system. After a long period of catching up, final figures are now ready 2-3 years after the year to which they refer, and the input-output table can be produced immediately after, as this is a purely technical matter which does not require any further estimation work on the data.

In principle the 4000 commodities are comparable over the whole

period after 1966, but in practice it has over time been necessary to aggregate some (because of changes in the basic commodity nomenclatures) and to accept other kinds of discontinuities. As a consequence of this the total number of commodities decreased from 4000 to less than 3000 from 1966 to 1978. Nonetheless it has been found extremely useful to carry out the balancing in the commodity-flow system at this detailed level, where each commodity has an immediately clear meaning.

Of course the balancing of the commodity flows and production accounts is carried out by extensive use of computer based procedures, but eventually the last differences are eliminated by conjectural procedures carried out by hand. As the emphasis in this paper is on the subsequent production of the input-output table, these procedures will not be described here, but it is important to realize that it is in this balancing process that the material contents of the input-out table are established, i.e. the national accounts picture of the real world is determined here, whereas the following construction of the input-output table is basically a question of presenting these data in a more aggregated and operational form with a minimum loss of information.

As mentioned above, the 4000 commodities are not strictly comparable over time, so even though it is useful to work at this level in the initial balancing and calculation of constant-price figures, a higher level of aggregation has been found appropriate for the purpose of recalculating the figures to a new base year for constant prices (in the recent change of base year from 1970 to 1975). This level contains about 1600 commodities, of which 500 are services which are not aggregated, as there are no problems of temporal comparability. The goods are simply aggregated to the four-digit CCCN nomenclature (i.e. the former BTN-nomenclature), which is possible because the first four digits at the 4000-commodity level are identical with the code numbers of the CCCN headings. In this way complete intertemporal comparability is secured at the 1600-commodity level. These series are available on an annual basis since 1966 (at present up till 1978) in current prices and in constant 1975 prices.

The preliminary input-output tables 1966-75:

The method applied in construction these tables is summarized below and fully explained in (DS 1973).

To each of the 4000 commodities an identification code for one of the 130 characteristic industries is attached. The characteristic industry is defined as the main producer of the commodity in 1966. Here as elsewhere in the paper the term "industries" also includes "other producers"

in the SNA meaning of the term. This code was then applied as an aggregation criterion, and 130 commodity groups were thus obtained, and the make matrix as well as the intermediate consumption part of the absorption matrix became square matrices. Please note that the above-mentioned medium level of aggregation (1600 commodities) was not applied at that time. Most commodities without Danish production (at the 4000-commodity level) were classified as non-competitive imports, and not given any code for characteristic industry. Imports of these commodities were in all subsequent calculations treated as a primary input.

By means of the well known SNA procedure an input-output table of the industry-industry type on the assumption of an industry technology was then calculated. The final demands were also included in this transformation process, and competitive imports were placed as negative final demand. In this way a complete input-output table with imports treated according to method C in "Input-output Tables and Analysis" (UN 1973) was obtained.

This table was named the "exogenous" version, because competitive imports in models based on it would be an exogenous variable. As a quantity model it raised some problems, although in some applications as for example calculation of energy contents it proved useful. As a basis for price models it was in some cases useful because of the limited number of exogenous prices it required.

In many uses, however, it was desirable to be able to calculate competitive imports as an endogenous variable, which required a separation of competitive imports from domestic production in each element of the matrices for intermediate consumption and final demands. This was done on the assumption that exports had no direct import contents, whereas all other uses of each characteristic commodity had the same proportion between imports and domestic production. Hereby imports were treated according to method D in (UN 1973).

Both sets of input-output tables (the "exogenous" and the "endogenous" version respectively) were placed in a data bank in connection with a special computer programme for IO analysis (based on the PASSION programme developed at the Harvard Economic Research Project in the sixties). The complete set of matrices for one year was made up of 46 matrices, 23 for the current-price tables and 23 for the constant-price matrices. Apart from the column totals all matrices contained coefficients only.

These tables have been used for many kinds of analysis, often in connection with supporting data matrices, for example of energy use in physical terms and employment figures, which have been fitted to the

classifications of the input-output table.

When these tables were labeled preliminary it was because they - under pressure of time and recourses - had been produced using the 1966 procedure, although it was planned to work out a new procedure (cf. below) which could take full advantage of the detailed basic data source, and also because a change in the classification of branches was planned (from 1958 ISIC to 1968 ISIC). Furthermore the constant-price tables would be recalculated from 1970 to 1975 as base year, which - taking place only at the 1600-commodity aggregation - would invalidate the concept of characteristic industry earlier used.

It was an indispensible requirement to the final tables that they should constitute an unbroken time series starting in 1966. The new branch classification was established by amalgating or resequencing the branches of the old one. As an exeption from this general rule, two new branches were created by subdivision: "Extraction of coal, oil and gas" and "Domestic services" (DS 1981). In this process the total number of branches decreased from 130 to 117. All national accounts data from 1966 and onwards have been reclassified according to the new classification.

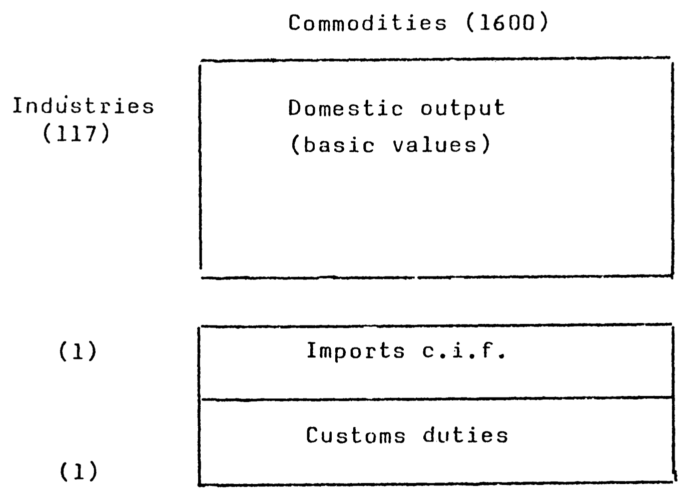
Basic features of the new techniques:

Compared with the detailed data base in the commodity flow system it is obvious that the above-mentioned method for constructing input-output tables introduced unnecessary aggregation errors by taking the round-about route represented by the initial aggregation to characteristic commodities. The main idea in the new method is to avoid this error by constructing the input-output matrices and the import matrices directly from the 1600-commodity level matrices.

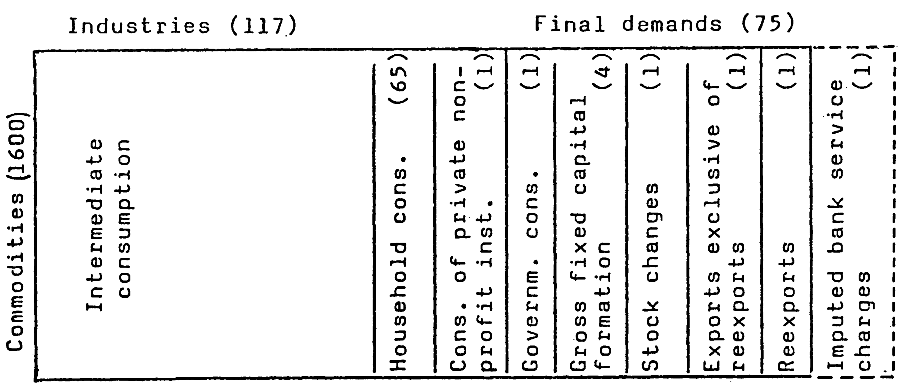
The two basic matrices are shown in figure 1 where numbers indicate matrix dimensions.

Figure 1. The make matrix and the absorption matrix.

The make matrix:



The absorption matrix:



These matrices exist for each year in current and constant prices. To facilitate the calculation of the input-output table the matrices shown above have been slightly modified compared with the arrangement of the matrices in the basic commodity-flpw system. This concerns the following four points.

1. Three artificial distribution sectors for "unspecified goods", "unspecified services" and "goods and services for repair and maintenance", each producing one commodity have been eliminated on the assumption that each sector receiving input of these commodities gets a basket of commodities equal to the input structure of the artificial sector in question.

2. Reexports have been deducted from the figures in the total export column. Ideally this can be done just by using the reexport figures given in the foreign trade statistics. In practice the matter is a good deal more complicated, because registered reexports can exceed imports of the commodity. In such cases the direct import contents of domestic uses would be negative. In other cases it happens that the domestic output of a commodity is less than total exports - reexports. In the first case it is assumed that reexports are equal to imports, and in the second case that total exports - reexports is equal to domestic output (which defines the size of the reexports). Solutions to other complications which can emerge, have also been built into the computer programme handling this procedure.

In the constant-price figures total exports are divided into reexports and the rest, by deflating reexports by the price index for imports, and calculating the constant-price value for the rest as a residual from the given constant-price value for total exports.

3. In the national accounts imputed bank service charges are treated as intermediate consumption. Technically this is implemented by having an artificial sector with imputed bank service charges as input and output equal to zero, which implies a negative gross operating surplus equal to the input.

To keep this artificial sector in the input-output table would cause problems for two reasons. Firstly, the output is zero and therefore input-coefficients are not defined. Secondly, if the sector was aggregated with the financial sector, this amalgamated sector would have a dominant own-delivery, and the small proportion of bank services which are actually paid for would have an enormous multiplier effect, which could invalidate the results of model calculations.

Therefore it has been decided to move imputed bank service charges to the final demand section of the table. This will remind the user of its existence and the need to take it into consideration if the financial sector (and consequently other sector) is to appear in a meaningful way in model calculations.

Finally it must be underlined that this treatment of imputed bank service charges implies that total GDP in the input-output table is calculated as the sum of value added in the individual branches less this element of final demands.

4. The six categories of stock changes have been added together to one single column, as the subdivision applied in the commodity-flow system is mainly of technical character, and not useful in the context of input-output tables.

<u>The treatment of imports:</u>

The distiction between competitive and non-competitive imports is not applied, but some special commodities which are not covered by the foreign trade statistics are singled out and treated as three categories of primary inputs in all versions of the input-output tables. The commodity contents of these rows are:

1. Goods and services imported directly to off-shore activities in the Danish part of the North Sea.
2. Purchases abroad by resident households and expenses for business trips etc. and purchases in Denmark by non-resident households etc.
3. Expenses abroad for Danish ships.

In the preceding chapter it was explained how reexports were isolated, and this of course is the same as calculating the direct import contents of exports. To make a complete disaggregation of the absorption matrix into one showing uses of domestic output and one showing uses of imports, it is necessary to make an assumption as to how the remainder of imports (i.e. imports cif + customs duties - reexports) is distributed among the categories of use.

For lack of any specific information it is assumed (for each of the 1600 commodities) that the ratio of domestic output to imports is identical in all domestic uses. Changes in stocks of work-in-progress and finished own products are of course always domestic output, and are so treated in the input-output table. The rather complicated computational procedure used in this connection will, however, not be discussed here.

It is important to note, that this assumption for imports is now applied at the detailed commodity level, whereas in the preliminary

tables it was applied at the level of 130 characteristic commodities, and therefore could lead to import figures in cells about which it was positively known that all input was of domestic origin (for instance agricultural input into dairies). This source of error is almost eliminated when imports are singled out at the detailed commodity level, and for model purposes it may often be more useful to assume identical import proportions in all domestic uses of an individual commodity than to use the actual more or less incidental or random figures for import contents - in cases where statistical information for such a procedure is in fact available, which is not the case for Denmark.

By the above-mentioned procedures the total absorption matrix has been subdivided into two matrices of equal dimensions - one for uses of domestic output, and one for uses of imports.

Three different aggregations of the resulting import matrix were carried out:

1. By means of the make matrix aggregation takes place to form industry groups (117) corresponding to the domestic industries. In principle the imported commodities are rearranged to suit a classification where each commodity is assumed to be distributed on producing industries in the same way as the domestic output of the commodity. (Technically the absorption matrix for imports is premultiplied by the make matrix in a coefficient form, the column totals of which are 1). As explained in the following section on the treatment of domestic output, a problem did arise in cases where no domestic output existed, as such commodities are not contained in the make matrix. The problem was solved by "assigning" a domestic industry to these commodities.

2. All commodities contained in the CCCN nomenclature (i.e. all goods) are aggregated over the first two digits of this nomenclature, which yeilds 99 rows (CCCN groups 01-99). All services are lumped together in one row (no. 100). The advantage of this classification is its direct comparability with current statistics, and the absence of any questions of interpretation.

3. A special aggregation for use in the macroeconometric model ADAM showing the ten divisions of SITC and an 11th group for services. This grouping was also worked out for exports. This aggregation is not in the input-output data bank.

The treatment of domestic output.

The absorption matrix for domestic output (at the 1600-commodity

level) is treated in a way parallel to the first aggregation mentioned above for the import matrix, i.e. it is premultiplied by the make matrix in a coefficient form. Clearly, the result is an industry x industry input-output table calculated on the assumption of an industry technology, which incidentally is the only possible technology assumption when the calculations are based on rectangular matrices. Also in this case a commodity x commodity table would not make any practical sense - but theoretically a 1600 x 1600 input-output table could be calculated.

It is worth noticing that the much discussed problems of which technology assumption to choose and whether to produce industry x industry or commodity x commodity tables are completely eliminated when maximum advantage is taken of a detailed data base in the construction of the table (cf. also UN 1973, p. 38).

As mentioned earlier there is no need for the concept of characteristic products in order to construct the input-output table by the new procedure. The make matrix does however automatically imply this concept if it is defined as the industry which is the main producer. Furthermore, for commodities which are not produced in Denmark (about 300 at the 1600-commodity level) it has been necessary to "define" a characteristic sector in order to carry out the first aggregation of the import matrix. In this way the concept of a "characteristic sector" has been defined for all commodities for the year 1975. It has, however, not been applied for any analytical purposes yet, but as there has been a considerable demand for data aggregated over characteristic sector in connection with the preliminary input-output tables, this concept must no doubt be reconsidered for the 1600-commodity level.

<u>A new concept: Selected commodities:</u>

It is generally accepted, that the distinction between competitive and non-competitive (complementary) imports is important in input-output analysis. The distinction is set out in SNA (UN 1968) and discussed in more detail in (UN 1973). From the latter the following passage might be quoted:

"The decision on classification (i.e. between competitive and complementary) may thus (because it depends on the level of disaggregation of commodities, p 60), to a certain extent, be arbitrary in particular cases and may need revision over time if domestic production ceases or commences. Finally, it should be noted that the classification will vary between economies and this may cause slight problems in international comparisons" (p. 61).

In the preliminary Danish input-output tables almost all commodities at the 4000-level disaggregation for which no Danish production took place in 1966 were classified as complementary. This meant that about 30 per cent of imports were so classified.

In the compilation of time series of input-output tables and the application of these in analysis, two problems showed up:

Firstly, for some product categories such as iron and steel work products which are partly produced in Denmark (but only by recycling waste) and partly imported, it was found that about half of the commodities were classified as complementary and the rest as competitive, even though it might from a common sense point of view had been expected to show a clear-cut example of complementary imports, as no iron ore is produced in Denmark. In input-output analysis the capacity limit for Danish output could not be taken into consideration, whereas on the other hand it would not make much sense to classify the actual Danish output as complementary. Similar cases arise for many other primary products such as agricultural products, and lately in the case of Denmark also for crude oil. Clearly these problems have no simple solution as their character is marginal in at system which is based on average ratios throughout.

Secondly, over time the above-mentioned definition of complementary imports strictly applied would imply that commodities had to be reclassified yearly, which would impair the concept in uses where it would be useful to interpret it as covering homogenous commodity groups - this would be the case both for complementary imports and for the groups of imports classified as competitive to the output of a specific domestic industry. In other words: a yearly reclassification of the goods would be necessary to stick to the ideal definition, but on the other hand such a reclassification would make the data more or less meaningless as time series.

It is obvious that these problems can be solved in specific applications of the input-output table, where it is used as a data base upon which a more sophisticated econometric model is constructed, and where marginal effects etc. can be taken into consideration. To producers of input-output tables which are required to be comparable over many years and to be useful in many different applications (of which many might not be known at the time the table is produced), the problem is, however, a much more difficult one, as discussed in Thage (1973).

In the following the solution which was finally chosen to this problem, is set out. It is based on three basic principles:

1. Maximum flexibility. The former "exogenous" and "endogenous" versions can be obtained as special cases from a more general system.
2. The link to the detailed rectangular data matrices is utilized and thereby makes clear to users that the input-output data system can be applied in connection with much more detailed data which are also available in a standard form. (In fact to show that the commodity-flow data are a system of consistent statistics which are comparable over time and available in connection with - but also without - the input-output tables).
3. To take into consideration that in many cases the user will primarily be interested in analysing the effects on certain key commodities of a specific policy and only secondarily in knowing whether the changes are of domestic or foreign origin. In recent years analysis of energy and other raw material problems, pollution and technological development and in general analysis of the inflationary process are examples to be mentioned.

These considerations led us directly to the concept of selected commodities, which simply meant to select from the absorption matrix (in the 1600 x 192 version) a number of commodities which might reasonably be called key commodities in the Danish economy. These commodities were arranged in special matrices corresponding in format to the input-output matrices and placed together with these in the data bank. It is important to note that no aggregation of these commodities took place, so that the rows in the matrices for selected commodities consist of four-digit CCCN groups. This means that they have a clear definition for users and can easily be connected with other statistical information (for example statistics for production, foreign trade and prices).

A total of 99 commodities were selected. Of the total supply of these commodities, 67 per cent consisted of imports, and these imports made up 52 per cent of total imports of goods (in 1975).

For practical reasons it was a priori decided, that the number of selected commodities should not exceed 100. But users with special wishes would have the possibility of selecting other goods from the absorption matrix by ad hoc procedures, as these matrices cannot be available in full in the input-output data bank. The commodities selected can broadly be said to consist of the following categories:

Agricultural products not produced in Denmark
Grain and other important feeding stuffs
Energy products
Fertilizers, basic plastics

Timber, pulp, paper
Wool, cotton, chemical fibres
Iron and steel (not fabricated)
Other metals (not fabricated)
Aircraft and parts thereof, computers
Transistors, microchips
Tractors, motorcars and parts thereof.

In annex 1 a full list of selected commodities is given. Energy products are only divided into four commodities, but in connection with the input-output tables there are also special energy matrices for all years since 1966 with show 25 kinds of energy, both in value and physical quantity terms.

In annex 1 the set-up of the matrices in the input-output table data bank is shown for one single year. In fact there are two such sets for each year - one in current prices and one in constant 1975 prices. It can be seen that the input-output table has been divided into many submatrices to facilitate calculations. In the data bank there are also two inverse matrices (nos. 16 and 17) which are the inverse of matrix no. 1 and matrices 1+4, respectively. All matrices with the exception of nos. 13, 14 and 15 are given in a coefficient form, but can be converted to absolute figures by means of the absolute column totals given in the three mentioned matrices.

The coefficient matrices for selected commodities are shown as nos. 21-23. In this form they can only be applied to calculate the total contents of these commodities or to trace price effects on special assumptions. But by means of the supporting coefficient matrices nos. 24-26 they can be changed into forms which are compatible with matrices nos. 1-6 and thereby allowing the generalizing of the treatment of imports.

A generalized treatment of imports:

As mentioned above, the matrices for selected commodities (nos. 21-23) have rows consisting of 4-digit CCCN groups. By applying the same procedure as described earlier for dividing the absorption matrix into a matrix for domestic production and a matrix for imports, the matrices 21-23 can each be so divided. The necessary information for this operation is contained in matrix 25 (import ratio in domestic uses) and matrix 26 (import ratios in exports). The result of this procedure is illustrated in figure 2.

Figure 2. The breakdown of selected commodities into domestic output and imports.

Original matrices for selected commodities (cf. annex 1):

		(117)	(66)	(9)
Domestic output and imports	(99)	21	22	23

After breakdown into domestic output and imports:

Domestic output	(99)	21a	22a	23a
Imports	(99)	21b	22b	23b

Figure 3. Illustration of symbols used in the definitions of "stripped" matrices.

Standard coefficient matrices (cf. annex 1):

		(117)	(66)	(9)
Total domestic output (uses) by industry	(117)	1 DA	2 DC	3 DD
Total imports (uses) classified by producing industry	(117)	4 MA	5 MC	6 MD

Coefficient matrices for selected commodities:

Domestic output of selected commodities by industry	(117)	SDA	SDC	SDD
Imports of selected commodities by industry	(117)	SMA	SMC	SMD

As described above, the breakdown of the original matrices for selected commodities takes place by applying the actual import ratios for the year in question given in the matrices 25 and 26. But it is of course also possible to choose different ratios for some or all commodities in individual calculations, the two extremes being (1) the import ratios for all commodities are 100 per cent (2) the import ratios for all commodities are zero. This flexibility in splitting up the original matrices makes it possible to take into account marginal conditions and to use what external information the analyst might possess.

After the above procedure has been carried out, the two sets of matrices are still on a commodity basis. From the total make matrix is singled out a partial matrix which contains the information concerning the 99 selected commodities. (Matrix no. 24 of dimension 117 x 99, cf. annex 1). By means of this matrix it is now possible to transform the matrices 21a-23a and 21b-23b into a form having industry identifications in the rows, i.e. matrices with 117 rows which can be subtracted from or added to the two sets of matrices 1-3 and 4-6, respectively. To facilitate the following exposition, the relevant sets of matrices (with the symbols used hereafter) are set out in figure 3.

In the following each of the four sets of matrices is symbolized by a single variable name. D is the common name for the matrices DA, DC and DD. Similarly the names M, SD and SM will be used for the three other sets of matrices, and S is defined as SD + SM.

Initially we shall assume that the matrices SD and SM have been calculated by means of the actual import ratios and relevant make matrix elements for the year in question. It is then obvious that these matrices are completely contained in D and M, respectively, and can be subtracted from them without leaving negative elements in the resulting matrices.

The traditional input-output matrices D and M stripped of their contents of selected commodities will then be:

$$(1)\quad D - SD$$

$$(2)\quad M - SM$$

And what we have subtracted adds up to the total matrix for selected commodities (both domestic and imported):

$$(3)\quad S = SD + SM = SD^{*} + SM^{*}$$

The matrices in (3) can be either the actual matrices of the year (S, SD, SM) or some specially constructed matrices SD^{*} and SM^{*} which can be obtained from the original matrices for selected commodities (fig. 2)

by applying other import ratios and possibly also a different partial make matrix. This allows the user to take into account any a priory information he might possess, and to make special assumptions regarding marginal changes.

Now we have the necessary instruments for illustrating the generalized treatment of imports by some standard cases. The basic idea is to add to the "stripped" matrices (1) and (2), matrices of selected imports. The only requirement to the matrices added is that the column totals must be equal to the column totals of matrix S.

The standard cases are first shown using the actual S, SD and SM matrices of the year. Line (a) shows matrices for delivery from domestic industries, line (b) endogenous imports exclusive of imports of selected commodities and line (c) endogenous imports of selected commodities.

"Stripped" matrices	Case 1	Case 2	Case 3
(a) D - SD	+ S	+ SD	+ 0
(b) M - SM	+ 0	+ 0	+ 0
(c) 0	+ 0	+ SM	+ S
Sum D + M - S	S	S	S

To exemplify how the above set-up is to be read the complete "case 2" model will be:

$$
\begin{aligned}
&(a) \quad D - SD + SD = D \\
&(b) \quad M - SM + 0 = M - SM \\
&(c) \quad 0 + SM = SM
\end{aligned}
$$

The three above cases for adding selected commodities to the "stripped" matrices have the following characteristics. In all cases it is assumed that endogenous imports of category (b), cf. above, are used according to the actual import ratios of the year. Through the three cases from 1 to 3 a still higher proportion of selected commodities are treated as endogenous imports.

In case 1 it is assumed that import ratios for all selected commodities are zero - or alternatively imports of these commodities can be determined exogenously.

In case 2 selected commodities are assumed to be domestically produced (or exogenous) and imported according to the average rates of the actual year. This case corresponds to the version which in the preliminary tables was named "endogenous".

In case 3 it is assumed that import ratios for all selected commodities are equal to one.

As matrices in line (b) and line (c) can be added, it is possible to form total import matrices, where imports of selected commodities are lumped together with other imports. It might be mentioned that in these cases it is possible to have import matrices in both lines (b) and (c) classified according to 2-digit CCCN groups, or to keep matrices in line (c) at the 4-digit CCCN grouping of the original matrix for selected commodities.

If the lines (a) and (b) are added we get three new cases, where it is assumed that imports exclusive of imports of selected commodities are zero - or alternatively determined exogenously. For imports of selected commodities the assumptions will be the same as in cases 1-3. The three new cases are:

"Stripped" matrices		Case 4	Case 5	Case 6
(a+b)	D + M - S	+ S	+ SD	+ 0
(c)	0	+ 0	+ SM	+ S
Sum	D + M - S	S	S	S

It is worth noticing that case 5 corresponds closely to the model version which in connection with the preliminary tables was named the "exogenous", although "complementary imports" is now defined from a different point of view.

In the above 6 cases the matrices SD and SM have been used to illustrate the standard case which could be commented upon by reference to fairly simple model structures and to the treatment of imports earlier applied. It is, however, important to point out that the new system gives an infinity of model possibilities when the matrices SD and SM are replaced by SD^* and SM^*, which can be tailored to specific uses. In many instances the user will probably be interested in giving a special treatment to only one or a few of the selected commodities. It is important to remember that in the calculation of the "stripped" matrices it is always the actual S, SD and SM of the year in question which must be used.

Above the matrix for imports exclusive of imports of selected commodities (M - SM) has been considered in its entirety only. But of course it is possible to subdivide also in this matrix (or the matrix M) into submatrices by separating out entire rows and to treat these in a way parallel to the subdivided S-matrix. As this is, however, not a new feature, it will not be further explored here.

A few examples may give an idea about the new possibilities of analysis in models based on the above structure.

In an analysis of the marginal effects of an increase in output of animal products it would be appropriate to set the import ratios for the selected commodities grain and feeding stuff at one, as no additional supply of these commodities will be available from domestic sources. On the other hand, if the harvest has been unusually large in a single year and an input-output table for an earlier year is used as a basis for model calculations, these ratios could be decreased on the average.

Suppose that the capacity of steel mills or oil refineries has changed drastically. For almost any kind of analysis it will then be necessary to change the import ratios for a number of selected commodities.

It is to be noted it is now meaningful to draw a distinction between input-output models for average and marginal analysis, respectively, and generally speaking it will be possible to incorporate many kinds of a priori knowledge into the input-output model in a rather precise way. For more special applications it will be possible to go to almost any degree of detail by drawing on the data in the basic commodity flow system.

Concluding remarks:

In the last decade there has been an enormous increase in the production of input-output tables and in their applications in still more fields of economic analysis. Apart from a general tendency to increase in the size of the tables there has, however, not been much development in the techniques of producing the tables or in their general appearance, as this has been instituted by the recommendations given in SNA.

The methods described in the present paper (and implemented for Denmark) must be seen as a step on the way to creating a more general concept of an input-output table which in close connection with the detailed data base of the national accounts can function as a flexible instrument for structural economic analysis at all levels.

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ANNEX 1

Contents of the data bank for input-output matrices.

The organization of the input-output matrices for a single year is illustrated on the following page. It is seen that the input-output table has been broken down into many submatrices to facilitate the use. For each year two sets of matrices are placed in the data bank - one in current prices, and one in constant (1975) prices. At present (spring 1982) the bank contains annual data for the period 1966-78, and 1979 will be added before the end of the year.

The data bank is placed at the computer center of the University of Copenhagen (RECKU) in connection with a programme packet for input-output analysis which is a further development of the PASSION packet worked out at the Harvard Economic Research Project in the sixties. In this way the data are directly available also to users outside the statistical office. The programme packet and how to get access to the data files is described in Folke (1981).

All matrices with the exception of nos. 13, 14 and 15 are stored in a coefficient form only, but by means of the absolute column totals in these three matrices they can be transformed into absolute figures if needed.

The set of matrices 1,3,4,6,7,9,10 and 12 represents the traditional input-output table in a coefficient form. The matrices 2,5,8 and 11 give a detailed breakdown of the column for total private consumption contained in matrices 3,6,9 and 12.

The two last pages of the annex give a complete list of industries, groups of final demand and primary inputs used in the input-output tables. The matrices where 2-digit CCCN groups are used do not need any further explanation, whereas a list of the 99 4-digitCCCN groups of selected commodities is given on the last page of the annex.

In principle all matrices are given in approximate basic value, but in connection with indirect taxes, net, on uses, which are all contained in the matrices for primary inputs, a total in purchasers' values for each use is obtained. This implies that matrix 13 is in approximate basic values, while 14 and 15 are in purchaser's values.

Organization of input-output matrices in the data bank:

		Intermediate consumption	Private consumpt. (subgroups)	Final demands (main gr.)
	Dim.:	117	66	9
Uses of domestic output classified by producing industry	117	1	2	3
Uses of imports classified in groups corresponding to the output structure of domestic industries	117	4	5	6
Uses of imports of special services etc.	3	7	8	9
Primary inputs	5	1o	11	12
Column totals (absolute)	1	13	14	15
Uses of imports classified by 2-digit CCCN groups (column totals equal to totals in matrices 4, 5 and 6)	1oo	18	19	2o
Selected commodities (domestic output and imports) classified by 4-digit CCCN groups	99	21	22	23

	Dim.:	99	1	1
Transformation matrices to be used in connection with matrices for selected commodities: 24: Partial make matrix 25: Import ratios in domestic uses 26: Import ratios in exports	117	24	99 25	99 26

Classification of industries (117) in the input-output table:

Precise definition of each industry in terms of ISIC 1968 and the Danish industrial classification is given in DS (1981).

1	Agriculture	34	Manufacture of wearing apparel
2	Horiculture	35	Manufacture of leather products
3	Fur farming, etc.	36	Manufacture of footwear
4	Agricultural services	37	Manuf.of wood products,excl.furnit.
5	Forestry and.logging	38	Manuf. of wooden furniture, etc.
6	Fishing	39	Manuf. of pulp, paper, paperboard
7	Extraction of coal, oil and gas	40	Manuf.of paper containers,wallpaper
8	Other mining	41	Reproducing and composing services
9	Slaughtering etc.of pigs and cattle	42	Book printing
10	Poultry killing, dressing, packing	43	Offset printing
11	Dairies	44	Other printing
12	Processed cheese, condensed milk	45	Bookbinding
13	Ice cream manufacturing	46	Newspaper printing and publishing
14	Processing of fruits and vegetables	47	Book and art publishing
15	Processing of fish	48	Magazine publishing
16	Oil mills	49	Other publishing
17	Margarine manufacturing	50	Manuf.of basic industrial chemicals
18	Fish meal manufacturing	51	Manuf.of fertilizers and pesticides
19	Grain mill products	52	Manuf.of basic plastic materials
20	Bread factories	53	Manuf.of paints and varnishes
21	Cake factories	54	Manufacture of drugs and medicines
22	Bakeries	55	Manufacture of soap and cosmetics
23	Sugar factories and refineries	56	Manuf. of chemical products n.e.c.
24	Chocolate and sugar confectionery	57	Petroleum refineries
25	Manufacture of food products n.e.c.	58	Manuf.of asphalt and roofing mater.
26	Manuf. of prepared animal feeds	59	Tyre and tube industries
27	Distilling and blending spirits	60	Manuf. of rubber products n.e.c.
28	Breweries	61	Manuf. of plastic products n.e.c.
29	Tobacco manufactures	62	Manuf. of earthenware and pottery
30	Spinning, weaving etc. textiles	63	Manuf. of glass and glass products
31	Manuf. of made-up textile goods	64	Manuf. of structural clay products
32	Knitting mills	65	Manuf. of cement, lime and plaster
33	Cordage, rope and twine industries	66	Concrete products and stone cutting

Classification of industries (continued)

67	Non-metallic mineral products n.e.c.	93	Steam and hot water supply
68	Iron and steel works	94	Water works and supply
69	Iron and steel casting	95	Construction
70	Non-ferrous metal works	96	Wholesale trade
71	Non-ferrous metal casting	97	Retail trade
72	Manufacture of metal furniture	98	Restaurants and hotels
73	Manuf. of structural metal products	99	Railway and bus transport, etc.
74	Manuf. of metal cans and containers	100	Other land transport
75	Manuf.of other fabr. metal products	101	Ocean and coastal water transport
76	Manuf. of agricultural machinery	102	Supporting services to water trsp.
77	Manufacture of industrial machinery	103	Air transport
78	Repair of machinery	104	Services allied to transport, etc.
79	Manufacture of household machinery	105	Communication
80	Manuf.of refrigerators, accessories	106	Financial institutions
81	Manuf.of telecommunication equipm.	107	Insurance
82	Manuf.of electrical home appliances	108	Dwellings
83	Manuf.of accumulators and batteries	109	Business services
84	Manuf. of other electrical supplies	110	Education, market services
85	Ship building and repairing	111	Health, market services
86	Railroad and automobile equipment	112	Recreational and cultural services
87	Manufacture of cycles, mopeds, etc.	113	Repair of motor vehicles
88	Professional and measuring equipm.	114	Household services
89	Manufacture of jewellery, etc.	115	Domestic services
90	Manuf.of toys, sporting goods, etc.	116	Private non-profit institutions
91	Electric light and power	117	Producers of government services
92	Gas manufacture and distribution		

Classification of private consumption expenditures:

1	Bread and cereals	35	Domestic services
2	Meat	36	Medical and pharmaceutical products
3	Fish	37	Therapeutic appliances and equipm.
4	Eggs	38	Physicians, dentists, etc.
5	Milk, cream, yoghurt, etc.	39	Hospital care and the like
6	Cheese	40	Accident and health insurance
7	Butter	41	Personal transport equipment
8	Margarine and lard	42	Maintenance of transport equipment
9	Fruits and vegetables	43	Gasoline and oils for trsp. equipm.
10	Potatoes, etc.	44	Other expenditure on trsp. equipm.
11	Sugar	45	Purchased transport
12	Coffee, tea, cocoa	46	Communication
13	Ice cream	47	Wireless and tv sets, gramophones
14	Chocolate and sugar confectionery	48	Photo and musical equipment, boats
15	Other foods	49	Other recreational goods
16	Non-alcoholic beverages	50	Maintenance of recreational goods
17	Beer	51	Entertainment,cultural services,etc.
18	Wine and spirits	52	Books, newspapers and magazines
19	Tobacco	53	Education
20	Clothing	54	Day-care institutions for children
21	Footwear	55	Barbers, beauty shops, etc.
22	Gross rents	56	Goods for personal care
23	Water charges	57	Jewellery, watches, rings, etc.
24	Electricity	58	Other personal goods
25	Gas	59	Writing and drawing equipment
26	Liquid fuels	60	Expenditure in restaurants
27	Other fuels	61	Expenditure for hotels and lodging
28	Furniture, fixtures, carpets, etc.	62	Financial services, n.e.c.
29	Household textiles,furnishings etc.	63	Service, n.e.c.
30	Major household appliances		Consumption in the domestic market
31	Repairs to major househ. appliances	64	-Purchases in DK by non-res.househ.
32	Glassware,tableware,househ.utensils	65	+Purchases abroad by res.households
33	Non-durable household goods		Consumption by resident households
34	Household services	66	+Cons. by private non-profit inst.

Classifications of final demands and primary inputs:

	MAIN GROUPS OF FINAL DEMAND		SPECIAL CATEGORIES OF IMPORTS
1	Private consumption	1	Direct imports to cont. shelf
2	Government consumption	2	Tourist transactions
3	Fixed inv. in machinery etc.	3	Expenses of Danish ships abroad
4	Fixed inv. in transp. equipm.		PRIMARY INPUTS
5	Fixed inv. in construction	1	Commodity taxes net (-VAT)
6	Inv. in breeding stocks	2	VAT on uses (net system)
7	Increase in stocks	3	Other indirect taxes net
8	Exports of goods and services	4	Compensation of employees
9	Imputed bank service charges	5	Gross operating surplus

Selected commodities:

Row no in matrices nos 21-23 and corresponding CCCN code

1	0801	26	3105	51	5501	76	7320
2	0901	27	3814	52	5505	77	7401
3	1001	28	3901	53	5506	78	7403
4	1002	29	3902	54	5509	79	7404
5	1003	30	4001	55	5601	80	7405
6	1004	31	4002	56	5605	81	7407
7	1005	32	4011	57	5606	82	7408
8	1201	33	4403	58	5607	83	7601
9	1507	34	4404	59	5804	84	7602
10	1512	35	4405	60	7105	85	7603
11	2205	36	4413	61	7107	86	7604
12	2209	37	4414	62	7301	87	7606
13	2304	38	4418	63	7302	88	8408
14	2307	39	4701	64	7303	89	8453
15	2401	40	4801	65	7307	90	8455
16	2510	41	4807	66	7308	91	8508
17	2701	42	5101	67	7310	92	8509
18	2709	43	5104	68	7312	93	8521
19	2710	44	5301	69	7313	94	8701
20	2711	45	5305	70	7314	95	8702
21	2816	46	5306	71	7315	96	8706
22	2840	47	5307	72	7316	97	8709
23	3102	48	5310	73	7317	98	8802
24	3103	49	5311	74	7318	99	8803
25	3104	50	5405	75	7319		

Part II.

Special Problems of Input-Output Statistics

CONNECTING NATIONAL ACCOUNTS AND INPUT-OUTPUT TABLES IN THE FEDERAL REPUBLIC OF GERMANY

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Introduction

The concepts for the traditional national accounts which - on a high level of aggregation - provide a comprehensive overview of the economic activities, and those of the input-output tables which present the network of production and distribution of commodities between the different branches of the economy in detail, have been developed quite independently from each other. The first national accounting systems of the United Nations (UN) and the Organization for European Economic Co-operation (OEEC)[1] were limited to the highly aggregated traditional accounts. A breakdown of some aggregates (e.g. national product by industries, consumers' expenditure by commodities) was given only in supplementary tables. The further discussion in the fifties revealed possibilities of integrating the national accounts and the data of input-output tables[2], but it revealed as well the difficulties. Differing aims of the two partial systems caused discrepancies with respect to concepts, definitions, classifications etc.

The further development of international systems of national accounts[3] included proposals for integrating input-output tables into a more comprehensive system of national accounts. However, the differing approaches in the systems of the United Nations and the European Communities, as well as the deviating national practices, showed that a generally accepted agreement on the most suitable form of linking the two partial systems has not been found up to now.

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1) Cf the first draft of a system of national accounts by R. Stone in: UN, Measurement of National Income and the Construction of Social Accounts, Studies and Reports on Statistical Methods, No. 7, Geneva 1947, and the first systems of the UN and OEEC. UN: A System of National Accounts and Supporting Tables, Studies in Methods, Series F No. 2, New York 1953, Rev. 1: 1960, Rev. 2: 1964. OEEC: A Simplified System of National Accounts, Paris 1950, and A Standardized System of National Accounts, Paris 1952 , 1958 Edition, Paris 1959. - 2) Cf especially the publications of R. Stone: R. Stone, J.E.G. Utting, The Relationship between Input-Output Analysis and National Accounting, in: Input-Output Relations, Proceedings of a Conference on Inter-Industrial Relations held at Driebergen, Holland (1953); R. Stone, Input-Output and the Social Accounts, in: T. Barna (Ed.), The Structural Interdependence of the Economy, Proceedings of an International Conference on Input-Output Analysis, Varenna 1954, New York, Milan; R. Stone, Input-Output and National Accounts, OEEC, Paris 1961. - 3) UN, A System of National Accounts (SNA), Studies in Methods, Series F No. 2, Rev. 3, New York 1968; Statistical Office of the European Communities, European System of Integrated Economic Accounts - ESA, Luxembourg, Brussels 1970, Second Edition 1979.

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In this paper some proposals for connecting input-output tables and national accounts are presented. Furthermore, the possibilities and difficulties of integrating the two partial systems are illustrated by the development of national accounting in the Federal Republic of Germany. The methods of the Federal Statistical Office for linking input-output and national accounts are presented in the final section. An example is given for the year 1975.

1. Proposals for connecting traditional national accounts and input-output tables

The suggestions for connecting traditional national accounts and input-output tables extend from a complete integration of the data of input-output tables into a system of national accounts to a system characterized by a rather loose connection between the two partial systems by means of a national commodity account. Three proposals which have been discussed especially on the international level, will be briefly outlined in the following:

a) A complete integration of input-output tables into a national accounting system will be possible only if the definitions for transactors and transactions coincide in the two partial systems. Using a uniform classification, the data of input-output tables can be integrated as production and generation of income accounts into a more comprehensive system of accounts which takes into account also the economic transactions in connection with income redistribution and use, as well as capital and financial transactions[4]. In this case, the choice of the statistical units depends on the question which type of statistical units participates in all economic transactions presented in national accounts and, secondly, for which statistical unit statistical data are available for all economic transactions. The statistical units used in this case are institutional units which are the smallest institutions preparing their own balance sheets (enterprises) or making out their own budgetary accounts (e.g. local authorities, welfare associations, private households).

   However, the decision for these economic units leads to difficulties in presenting commodity flows in input-output tables. Enterprises often do not produce one specific commodity group only, but commodities of different kinds. Therefore, the transactions between the institutional units in the input-output tables cannot be identified with specific commodity groups. Information on the commodity input and output structures of branches defined by commodities is given only to a limited

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4) A complete integration of input-output data in a system of national accounting had been envisaged by R. Stone in the fifties. He suggested an integrated system presented in a so-called Social Accounting Matrix.

degree. R. Stone called the use of one type of statistical units for all transactions the "solution of Procrustes"[5]. Economic transactions of too different kinds are forced into a uniform classification scheme.

b) Richard Stone therefore suggested in the early sixties to use for each part of the national accounting system the most adequate statistical unit[6]. The parts of the system (e.g. production, income and financial accounts) should be linked by means of transition matrices which show the same aggregates (e.g. gross output) in a breakdown by two different classifications. The use of multiple classifications combined with transition matrices became one of the basic principles of presentation of the revised System of National Accounts (SNA)[7]. The input-output table, as an integrated part of the system of national accounts, shows all transactions in connection with the production and distribution of commodities and the generation of income. The transactions in the input-output tables are classified by commodity groups and industries. The statistical units, used for the industry classification, are establishments. Establishments are units which are relatively homogeneous in respect of the character, cost-structure and technology of production. In other parts of the system, the transactions are classified by institutional sectors with institutional units such as enterprises, government and private households.

The multiple classification scheme of the SNA has the great advantage that for each kind of transaction the most appropriate statistical unit can be chosen. For this choice, classifications of the original statistical data could be taken into account. A disadvantage of using differing classifications is the complexity of such a type of national accounting system[8]. It is difficult to connect economic transactions which are linked in the accounting system by more than one transition matrix, e.g. transactions of the production and the financial spheres.

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5) R. Stone, Multiple Classifications in Social Accounting, in: Bulletin of the International Statistical Institute, Volume XXXIX, Part 3, 1962. - 6) See R. Stone, Multiple Classifications ..., a.a.o., and A Programme for Growth, Vol. 1: A Computable Model of Economic Growth, Cambridge 1962, Vol. 3: Input-Output Relationships 1954 - 1966, Cambridge 1973. A similar approach was given by G. Rosenbluth, Analytical Uses of Commodity-by-Industry-Accounts, CPSA Conference on Statistics, 1964, Papers, Toronto 1966, and Input-Output Analysis: A Critique, in: Statistische Hefte, Vol. 9, No. 4 (1968). - 7) UN, Studies in Methods, Series F No. 2, Rev. 3, New York 1968. - 8) Cf especially the discussion in: Helen Stone Tice, Report of a Conference on the Proposals for Revision of the United Nations System of National Accounts, held by the Conference on Research in Income and Wealth (June 1966), in: Review of Income and Wealth, Series 13, 1967, and J.W. van Tongeren, A Review of Selected Aspects of the United Nations System of National Accounts in the Light of Countries' Experiences, in: Review of Income and Wealth, Series 25, June 1979.

c) A loose connection between the input-output tables and other parts of the accounting system is given in the European System of Integrated Economic Accounts (ESA)[9]. The transactions in respect of the supply and distribution of commodities are classified by branches which are composed of homogeneous production units, each producing only one specific commodity group[9a]. The data of the input-output tables can be used to establish production and generation of income accounts for each branch of the input-output table. Transactions of income distribution, income redistribution and use of income, as well as capital formation and financing, are not presented for branches. A complete system of accounts is given only for transactions in institutional classification (with enterprises as statistical units). While the input-output tables are presented in a detailed breakdown by 44 branches, the institutional classification is limited to a few highly aggregated sectors. A connection of commodity and institutional accounts is established only by a commodity account for the economy as a whole.

The commodity classification of the input-output tables as presented in the ESA seems to be the best classification for input-output analysis, because the transactions are allocated to specific commodity groups in an unambiguous manner and thus they are not subject to the contingencies of the combination of commodity groups produced by institutional units. Nevertheless, commodity by commodity tables have disadvantages: the basic statistical data, classified mostly by institutions, must be converted, because the "homogeneous production unit" is an abstraction existing in reality only in exceptional cases. The separation of commodity by commodity tables from national accounts with institutional units furthermore leads to a situation where the statistical data of the input-output tables cannot be used without difficulties for setting up the accounts and vice versa. Furthermore, results of input-output analysis cannot be applied to institutional sectors right off.

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9) Cf the comments in the ESA and in: Statistical Office of the European Communities, Methodology of Input-Output Tables for the Community, 1970 - 1975, Special Series 1-1976. Regarding the differences between the ESA and the SNA, cf the paper of the Statistical Office of the European Communities , Document 13.809/ST/69-D of 9 July 1969,and G. Hamer, Grundzüge der neuen internationalen Standardsysteme Volkswirtschaftlicher Gesamtrechnungen in: Allgemeines Statistisches Archiv, Vol. 53, 1969. - 9a) For describing the different types of statistical units and the sectors composed of them, it is used in the following: homogeneous production units and branches, establishments and industries, enterprises and institutional sectors.

2. Input-output and national accounting in the Federal Republic of Germany

The first official estimates of the national product of Germany were performed between the two world wars[10]. In the Federal Republic of Germany, activities in national accounting were taken up in 1949. Hildegard Bartels published first deliberations on the development of a system of national accounts in 1951[11]. At the beginning of the sixties, a system of national accounts was published which - with respect to the sector classification of the economy and the consideration of financial transactions - went beyond the international systems of national accounting existing at that time[12]. In the sixties however, this system could not be filled in completely[13]. Modifications in the concepts and definitions became necessary in the seventies due to the adjustment of national accounting to the ESA. But while the ESA provided for the production and generation of income accounts a more detailed presentation according to branches defined by commodities and an institutional classification for highly aggregated sectors only, the Federal Statistical Office maintained the institutional classification aspect (with enterprises etc. as statistical units) also in the more detailed breakdown by sectors[14]. For analysing the structural changes in the Federal Republic of Germany gross output, intermediate consumption, and gross value added (with its components), have been computed for 57 institutional sectors[15].

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10) Regarding the history of national accounting in Germany, cf P. Studenski, The Income of Nations, Theory, Measurement and Analysis: Past and Present (New York 1958) 2nd ed. 1961, Part 1: History; A. Stobbe, Volkswirtschaftliche Gesamtrechnung, in: Handwörterbuch der Wirtschaftswissenschaft, 17th/18th delivery 1979; P. Jostock, Von der ersten Volkseinkommensberechnung bis zur volkswirtschaftlichen Gesamtrechnung, Allgemeines Statistisches Archiv, Vol. 36, 1952; G. Bombach, Kreislauftheorie und volkswirtschaftliche Gesamtrechnung, Jahrbuch für Sozialwissenschaft, Vol. 11, 1960, pp. 217 - 242, 331 - 350. - 11) H. Bartels, Probleme der Volkswirtschaftlichen Gesamtrechnungen, in: Wirtschaft und Statistik, 1951, No. 6. - 12) H. Bartels, Das Kontensystem für die Volkswirtschaftlichen Gesamtrechnungen der Bundesrepublik Deutschland, Erster Teil: Das angestrebte Kontensystem, in: Wirtschaft und Statistik, 1960, No. 6. - 13) H. Bartels, K.-H. Raabe, O. Schörry, Das Kontensystem für die Volkswirtschaftlichen Gesamtrechnungen der Bundesrepublik Deutschland, Zweiter Teil: Das ausgefüllte vereinfachte Kontensystem, Wirtschaft und Statistik, 1960, No. 10. - 14) Detailed comments on content and design of traditional national accounting are provided by the annual volumes of the Federal Statistical Office, Fachserie 18: Volkswirtschaftliche Gesamtrechnungen, Reihe 1: Konten und Standardtabellen (last published for 1980), as well as by the methodological studies in "Wirtschaft und Statistik". Regarding the relation of the nationally applied system of national accounting to the ESA, see also D. Gottstein, The European System of National Accounts in Comparison with the System of National Accounts of the Federal Statistical Office, in: Statistische Hefte, 3/1978. An outline of national accounting in the Federal Republic of Germany in English is given in the OECD report: Structure and Sources of National Accounts in Germany, Paris 1975. - 15) See M. Engelmann and associates, Ergebnisse der Volkswirtschaftlichen Gesamtrechnungen für Zwecke der sektoralen Strukturberichterstattung, in: Wirtschaft und Statistik, 1979, No. 10.

In the Federal Republic of Germany, input-output tables were set up at first only by non-official agencies. After first attempts by F. Grünig[16], the first larger input-output table for the Federal Republic with 46 sectors was published in 1959 by W. Krelle for the year 1953[17]. This input-output table was classified by commodities. The main aggregates had been adjusted to the data of national accounting. The German economic research institutes such as the Deutsches Institut für Wirtschaftsforschung (DIW), the Rheinisch-Westfälisches Institut für Wirtschaftsforschung (RWI) and the Ifo-Institut für Wirtschaftsforschung (Ifo), began in the early sixties with compiling input-output tables[18]. In the late sixties, the Federal Statistical Office included the input-output tables in its official work programme, although some members of its staff had already computed input-output tables for the year 1960 within the scope of a project of the European Community (EC)[19].

The input-output computations of the Federal Statistical Office are closely adapted to the requirements of the Statistical Office of the European Communities (SOEC)[20]. In accordance with the ESA, the input-output tables are commodity by commodity tables, with homogeneous production units as statistical units. The commodity flows are defined according to the concept of total production, i.e. inclusive of the production of commodities of the enterprises for their own use. Trade transactions are shown on a net basis, i.e. the market value is reduced by the delivered costs of the goods. The statistical units and the definitions of the transactions thus differ essentially from those in traditional national accounting in the Federal Republic of Germany which uses institutional units (enterprises etc.) and concentrates mainly on the presentation of market transactions: National accounts are set up only for institutional sectors and the connection to input-output computations is accomplished by

16) F. Grünig, Versuch einer volkswirtschaftlichen Input-Output-Rechnung für die Bundesrepublik, in: Vierteljahreshefte zur Wirtschaftsforschung, Berlin 1953. Cf R. Krengel, Die Anfänge der Input-Output-Rechnung des DIW für die Bundesrepublik Deutschland, in: Kyklos, Vol. 32, 1979. - 17) W. Krelle, Volkswirtschaftliche Gesamtrechnung einschließlich input-output-Analyse mit Zahlen für die Bundesrepublik Deutschland, Berlin 1959. - 18) A good survey is given in the articles by R. Stäglin: Zum Stand der Input-Output-Rechnung in der Bundesrepublik Deutschland, in: Konjunkturpolitik, Volumes 5-6/1968; Zur Input-Output-Rechnung in der Bundesrepublik Deutschland - Eine Bestandsaufnahme, in: J. Frohn, R. Stäglin (Ed.), Empirische Wirtschaftsforschung - Konzeptionen,Verfahren und Ergebnisse, Festschrift für Rolf Krengel aus Anlaß seines 60. Geburtstages, Berlin 1980. Regarding the input-output tables of the Ifo-Institute, cf G. Gehrig and associates, Input-Output Studien, Vols. 1 to 10, Munich 1969; regarding the tables of the RWI, cf E. Korthaus, R. Rettig, B. Hillebrand, Input-Output-Tabellen für die Bundesrepublik Deutschland 1962 bis 1975, RWI-Papiere No. 8, Essen 1979. - 19) H. Bartels, G. Hanisch, G. Lauckner, Möglichkeiten und Grenzen der Berechnung von Input-Output-Tabellen für die Bundesrepublik Deutschland, in: Wirtschaft und Statistik, 1965, No. 2. - 20) Content and design of the input-output tables as well as the computation methods are described in Fachserie 18: Volkswirtschaftliche Gesamtrechnungen, Reihe 2: Input-Output-Tabellen 1975, Stuttgart, Mainz 1981.

means of a commodity account for the whole economy. This relation between input-output computations and the national accounts corresponds with the already described concept of the ESA with its rather loose connection between the two partial systems of national accounting. However, it has been possible to establish a linkage in a detailed breakdown between the institutional data of national accounting and the commodity-defined data of input-output tables[21]. The transition model used for this purpose will be explained in the next section.

In compiling input-output tables, the German Institute for Economic Research (DIW) closely followed the concepts of traditional national accounting in the Federal Republic of Germany[22]. Thus, institutions such as enterprises and local authorities are used as statistical units; the emphasis is mainly on the presentation of market transactions. The DIW tables are suitable for a full integration into the German system of national accounts; due to the institutional classification in both systems, transition tables are not necessary.

The coexistence of input-output tables with commodity classifications (Federal Statistical Office, Ifo-Institute, RWI) and input-output tables with institutional sectors (DIW) for the Federal Republic of Germany has led to discussions on the most suitable conception for input-output tables. In particular, it is being discussed which economic units are most appropriate for the presentation of production and income transactions[23].

The statistics used for input-output computations do not permit an unambiguous decision in favour of one specific type of statistical unit[24]. Data on gross output are available both in an institutional classification (e.g. enterprises) and in a breakdown by commodity groups. An annual special processing of production statistics classified both by enterprises and commodity groups is available since 1978, which pro-

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21) Cf C. Stahmer, Verbindung von Ergebnissen der herkömmlichen Sozialproduktsberechnung und der Input-Output-Rechnung: Überleitungsmodell des Statistischen Bundesamtes, in Allgemeines Statistisches Archiv, 1979, No. 4. - 22) Cf R. Stäglin, Input-Output-Rechnung, Aufstellung von Input-Output-Tabellen, Konzeptionelle und empirisch-statistische Probleme, in: DIW-Beiträge zur Strukturforschung, Vol. 4, 1968. - 23) Cf K.-H. Raabe, Statistische Unterlagen für die Erstellung einer Input-Output-Tabelle, in: Allgemeines Statistisches Archiv, 1965; W. Thon, Die Eignung verschiedener Typen industriestatistischer Erhebungseinheiten für die Input-Output-Analyse, in: Statistische Hefte, Vol. 6, 1965. Regarding the use of different types of statistical units in economic statistics, see G. Fürst, Unternehmen, fachliche Unternehmensteile und örtliche Einheiten als Grundlage für die statistische Darstellung wirtschaftlicher Tatbestände, in: Wirtschaft und Statistik, 1957, No. 12; R. Wagenführ, Möglichkeiten der Systematisierung der modernen Wirtschaftsstatistik, in: Allgemeines Statistisches Archiv, Vol. 51, 1967. - 24) Regarding the basic statistics, see A. Sobotschinski, Die Neuordnung der Statistik des Produzierenden Gewerbes, in: Wirtschaft und Statistik, 1976, No. 7.

vides a good basis for setting up a matrix allocating the commodities to the institutional sectors. Data on input structures are available for enterprises only, but the inputs of the enterprises are given in a commodity classification.

The data available on the production and distribution of commodities in the Federal Republic of Germany can best be presented in two tables which correspond to the make matrix and the absorption matrix of the SNA. The make matrix represents the production of industries in the breakdown by commodity groups, while the absorption matrix shows the inputs of industries by commodities. Differing from the SNA, however, the statistical data in the Federal Republic of Germany do not permit a classification by industries with establishments as statistical units, but only one by institutional sectors, composed of enterprises etc. The statistical units are therefore enterprises instead of establishments. The Federal Statistical Office has already published a make matrix[25]. The available absorption matrix has been incomplete up to now. Within the framework of traditional national accounting the gross value added (with subdivisions by components), the gross output and total intermediate consumption are published in detailed breakdown by institutional sectors. The Federal Statistical Office plans to set up a complete absorption matrix, including a breakdown of the intermediate consumption of the institutional sectors by commodity groups. This matrix will be used in a first step for internal purposes only. The most important statistics for the computation of this matrix will be the 1978 survey of materials and products received in mining and manufacturing and the annual cost structure statistics.

With setting up a make matrix and an absorption matrix, the Federal Statistical Office will adapt itself to a greater extent to the classification concepts of the SNA. According to the SNA concept of selecting in each case the adequate classification for presenting transactions, a breakdown is being used both by commodities and by institutional sectors.

The breakdown by institutional sectors provides a direct linkage of gross value added by sectors and the institutionally classified income accounts. The breakdown of outputs and inputs by commodities provides the basis for analysing the commodity flows in the economy.

The acceptance of the "classification philosophy" of the SNA does not cut off the two other mentioned possibilities of connecting input-output tables with traditional national accounting. On the contrary, the data in the SNA arrangement provide a suitable basis for the computation of input-output tables by other classification as-

25) Fachserie 18: Volkswirtschaftliche Gesamtrechnungen, Reihe 2, Input-Output-Tabellen 1975, Stuttgart, Mainz 1981.

pects. By rearranging the columns of the absorption matrix by means of the data of the make matrix, it is possible to compute the matrix of intermediate consumption of a commodity by commodity input-output table. By rearranging the rows of the absorption matrix, it is possible to compute the matrix of intermediate consumption of an institutionally classified input-output table. The commodity by commodity table corresponds to the requirements of the ESA, while the input-output table with institutional classifications makes it possible to integrate the data of the input-output table in a national accounting system with uniform classifications.

The Federal Statistical Office has already computed data of a commodity by commodity table by transforming institutional results of traditional national accounting. The transition model used will be described in the next chapter.

3. Transition model of the Federal Statistical Office

This chapter deals with the transition from the institutional data of the traditional national accounting to the commodity classification of the input-output tables[26]. This transition is illustrated by an example for the year 1975.

The problems of converting the data for institutional units to data classified by commodity groups have existed since the beginning of input-output computations[27]. In input-output tables, commodity classifications should be used as far as possible, while on the other hand the basic statistics are often available only for institutional units. Especially data on inputs (intermediate consumption, value added with its components: capital consumption, production taxes, subsidies, income) are in most cases compiled only for institutional units. Often, the institutional units can provide data on their gross output in a breakdown by commodities, but they generally have difficulties to allocate the inputs to the commodities produced. While an allocation is easily possible in the case of direct costs of the production of commodities, it is more difficult to give a breakdown of the overhead costs (e.g. costs for administration, research, distribution, etc.).

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26) A detailed description of the transition model is given in the mentioned article by C. Stahmer. - 27) See D.W. Evans, Input-Output-Computations, in T. Barna (Ed.), The Structural Interdependence of the Economy, Proceedings of an International Conference on Input-Output-Analysis Varenna 1954, New York and Milan; J.H. Edmonston, A Treatment of Multiple-process Industries, Quarterly Journal of Economics, 1952; R. Stone, Input-Output and National Accounts, Paris 1961, Chapter II; R. Stäglin, Input-Output-Rechnung, op. cit., pp. 19 - 43; United Nations, Problems of Input-Output Tables and Analysis, Studies in Methods, Series F, No. 14, New York 1966, especially Chapter II.

In the early sixties, Richard Stone developed a procedure to derive a commodity by commodity table from data available in a breakdown by industries as well as commodity groups[28]. The transition model of Stone has been taken over by the SNA[29]. The data on inputs and outputs of the industries in a breakdown by commodities were described already as partial systems of the SNA. Using data on the output structure the input structures of the industries are being transformed to input structures of branches defined by commodities. Two assumptions (and combinations of these assumptions) are being applied:

a) The commodities are produced with the same input structure, independent of the industry in which the production is actually taking place (commodity technology).

b) The commodities are produced with the input structure of the industry in which the production is taking place (industry technology).

The first assumption will be justified, if the secondary production of the industry is independent of the production of commodities performed as main activity. The second assumption will most likely be applied if secondary activities concern by-products[30].

The transition procedure developed by Stone has been applied by the Federal Statistical Office in a somewhat modified form for converting the data of traditional national accounting[31] (with enterprises etc. as statistical units) for the years 1970 to 1977 to the commodity classification of the input-output tables. Within the framework of traditional national accounting, the data available include gross output, the total of intermediate consumption and gross value added in a breakdown by 57 institutional sectors. The gross value added is additionally subdivided by consump-

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28) See the above mentioned studies by R. Stone, A Programme for Growth, Vol. 1 and Vol. 3. Regarding the transition procedure, cf also C. Almon, Investment in input-output models and the treatment of secondary products, in: A.P. Carter, A. Brody, Application of Input-Output Analysis, Amsterdam 1969; T. Gigantes, The representation of technology in input-output systems, in: A.P. Carter, A. Brody (Eds), Contributions to Input-Output Analysis, Amsterdam, London 1970; A.G. Armstrong, Technology Assumptions in the Construction of U.K. Input-Output Tables, in: I.G. Stewart (Eds.), Aspects of Input-Output Analysis, Edinburgh 1972; R.C. Cressy, Commodity and Industry Technology: Symbols and Assumptions, in: The Manchester School, Vol. 44, 1976; United Nations, Input-Output Tables and Analysis, Studies in Methods, Series F, No. 14, Rev. 1, New York 1973. A comparison of the transition model of Stone with a micro-economic approach is given in a very interesting article, published in this volume: J.-F. Divay, F. Meunier, Two methods of constructing "input-output" tables. 29) Cf SNA (1968), annex to chapter III. - 30) Cf SNA (1968) p. 50. - 31) Cf Statistisches Bundesamt, Fachserie 18: Volkswirtschaftliche Gesamtrechnungen, Reihe 1: Konten und Standardtabellen, last publication for 1980, Stuttgart, Mainz 1981.

tion of fixed capital, production taxes, subsidies, compensation of employees, as well as operating surplus. For the transition, make matrices for the years 1970 to 1977 are available, which show the output structure of 60 institutional sectors in a breakdown by 60 commodity groups.

Before converting the institutional data to the commodity classification, it was necessary to modify the gross output and the intermediate consumption according to the ESA concepts used in the input-output tables. In the traditional national accounting of the Federal Statistical Office, the emphasis of the presentation - as mentioned already - is on the market transactions, while according to the ESA concept prime consideration is given to the presentation of the network of commodity flows. The transactions of the trade sector are shown according to the ESA by their net value and transactions within the enterprises are included. Table 1 presents the data for 1975 in a breakdown by 12 aggregated institutional sectors according to the ESA concept. Table 1 corresponds to the absorption matrix of the SNA; intermediate consumption, however, is not subdivided by commodities. This breakdown and a subsequent transition of the data is envisaged.

Table 2 shows the data on the gross output of 12 institutional sectors for 1975 in a breakdown by commodity groups. The transactions are defined according to the ESA concept. This table corresponds to the make matrix of the SNA. The totals of the rows are the gross output of the branches of a commodity by commodity table. The data in Table 2 show that the secondary activities on the given level of aggregation are relatively unimportant. They amount on the average to about 7 % of the total gross output of the respective institutional sector. In the breakdown of the gross output by 60 branches and institutional sectors, the average proportion of secondary activities is about 10 %. In these cases the relative importance of secondary activities is greater than in make matrices with establishments as statistical units[32]: the manufacturing programme of enterprises has a wider spread than that of establishments which are relatively homogeneous with respect to the commodity groups produced.

Table 3 shows the input data converted to a commodity classification. The data in Table 3 correspond to the matrix of gross value added of a commodity by commodity table. A comparison between the data of Table 1 and Table 3 reveals the relatively small differences of the data before and after transition. It should be mentioned that these tables represent aggregations of tables covering 60 branches. The transi-

32) Based on a classification by 70 sectors, Armstrong indicates for Great Britain a proportion of secondary activities amounting to about 5 %, see United Nations, Input-Output Tables and Analysis, op.cit., p. 34.

Table 1: Inputs 1975 by Institutional Sectors

Ser. No.	Institutional Sector[1)] / Input	Agriculture, Forestry, Fishing	Electricity, Gas and Water; Mining	Manufacturing: Chemicals, Petroleum, Plastic and Non-Metallic Mineral Products; Quarrying	Manufacturing: Basic Metals	Manufacturing: Machinery except Electrical; Transport Equipment	Manufacturing: Electrical Machinery, Fabricated Metal Products n.e.c.	Manufacturing: Textiles, Leather, Wood, Paper and Products	Manufacturing: Food, Beverages, Tobacco	Construction	Trade, Transport and Communication Services	Other Market Services	Non-Market Services	Institutional Sectors, Total
		1	2	3	4	5	6	7	8	9	10	11	12	13
		Million Deutsche Marks												
1	Intermediate Consumption	47 644	43 528	132 946	121 986	130 213	69 336	82 883	97 631	92 172	101 434	105 937	123 840	1 149 550
2	Gross Value Added	30 780	41 250	84 530	36 020	94 630	65 380	57 010	48 040	70 560	161 200	218 540	141 120	1 049 060
3	Consumption of Fixed Capital	6 730	8 330	10 890	4 570	9 360	5 250	4 830	4 820	4 500	18 490	31 940	7 320	117 030
4	Production Taxes less Subsidies	240	6 330	20 680	3 240	4 810	5 950	6 240	16 120	8 910	6 910	14 120	190	93 740
5	Compensation of Employees	5 010	17 020	41 130	23 220	69 390	45 610	35 720	18 280	41 750	95 360	56 250	133 610	582 350
6	Operating Surplus	18 800	9 570	11 830	4 990	11 070	8 570	10 220	8 820	15 400	40 440	116 230	-	255 940
7	Gross Output	78 424	84 778	217 476	158 006	224 843	134 716	139 893	145 671	162 732	262 634	324 477	264 960	2 198 610
		Percent of Gross Output												
8	Intermediate Consumption	60,8	51,3	61,1	77,2	57,9	51,5	59,2	67,0	56,6	38,6	32,6	46,7	52,3
9	Gross Value Added	39,2	48,7	38,9	22,8	42,1	48,5	40,8	33,0	43,4	61,4	67,4	53,3	47,7
10	Consumption of Fixed Capital	8,6	9,8	5,0	2,9	4,2	3,9	3,5	3,3	2,8	7,0	9,8	2,8	5,3
11	Production Taxes less Subsidies	0,3	7,5	9,5	2,1	2,2	4,5	4,4	11,0	5,5	2,7	4,3	0,1	4,3
12	Compensation of Employees	6,4	20,1	18,9	14,7	30,9	33,9	25,5	12,5	25,7	36,3	17,3	50,4	26,5
13	Operating Surplus	24,0	11,3	5,4	3,2	4,9	6,4	7,3	6,1	9,5	15,4	35,8	-	11,6
14	Gross Output	100	100	100	100	100	100	100	100	100	100	100	100	100

1) The institutional sector consists of a grouping of enterprises etc.-For a comparison of the classification of the institutional sectors with the International Standard Industrial Classification (ISIC) of annex.

Table 2: Gross Output 1975 by Commodity Groups and Institutional Sectors

Million Deutsche Marks

Scr. No.	Institutional Sector[1)] / Commodity Group	Agriculture, Foresty, Fishing	Electricity, Gas and Water; Mining	Manufacturing: Chemicals, Petroleum, Plastic and Non-Metallic Mineral Products; Quarrying	Manufacturing: Basic Metals	Manufacturing: Machinery except Electrical; Transport Equipment	Manufacturing: Electrical Machinery, Fabricated Metal Products n.e.c.	Manufacturing: Textiles, Leather, Wood, Paper and Products	Manufacturing: Food, Beverages, Tobacco	Construction	Trade, Transport and Communication Services	Other Market Services	Non-Market Services	Institutional Sectors, Total
		1	2	3	4	5	6	7	8	9	10	11	12	13
1	Agricultural, Foresty and Fishing Prod.	76 300	-	-	-	-	-	-	-	-	-	-	-	76 300
2	Electricity, Gas, Water, Mining Prod.	-	78 962	2 388	3 986	111	52	388	78	345	575	-	-	86 885
3	Chem., Petr., Plast. and Non-met. Min. Prod.	-	672	203 783	1 484	605	1 478	3 366	241	1 616	1 957	-	-	215 202
4	Basic Metals	-	707	1 537	141 767	7 985	3 114	67	-	-	1 416	-	-	156 593
5	Machinery except Electr.; Transport Equipment	27	325	940	6 326	196 030	5 423	282	23	10 513	6 401	-	-	226 290
6	Electr. Machinery, Fabr. Metal Prod. n.e.c.	3	782	1 978	2 813	3 630	116 135	592	-	-	1 814	-	-	127 747
7	Text., Leather, Wood, Paper and Prod.	-	-	1 720	2	864	1 143	130 924	248	4 807	1 857	950	-	142 515
8	Food, Beverages, Tobacco	673	-	398	-	107	95	184	141 081	-	6 589	1 196	-	150 323
9	Construction	120	1 050	752	293	4 540	571	119	117	141 632	1 319	-	170	150 683
10	Trade, Transport and Communication Services	262	1 869	3 684	875	5 759	2 841	2 065	2 271	1 594	233 488	1 250	-	255 958
11	Other Market Services	1 039	411	296	460	5 212	3 864	1 906	1 612	2 225	7 218	321 081	-	345 324
12	Non-Market Services	-	-	-	-	-	-	-	-	-	-	-	264 790	264 790
13	Commodity Groups, Total	78 424	84 778	217 476	158 006	224 843	134 716	139 893	145 671	162 732	262 634	324 477	264 960	2 198 610

1) The institutional sector consists of a grouping of enterprises etc.-For a comparison of the classification of the institutional sectors with the ISIC cf annex.

Table 3: Inputs 1975 by Branches

Scr. No.	Input / Branch[1]	Agriculture, Forestry, Fishing	Electricity, Gas and Water; Mining	Manufacturing: Chemicals, Petroleum, Plastic and Non-Metallic Mineral Products; Quarrying	Manufacturing: Basic Metals	Manufacturing: Machinery except Electrical; Transport Equipment	Manufacturing: Electrical Machinery, Fabricated Metal Products n.e.c.	Manufacturing: Textiles, Leather, Wood, Paper and Products	Manufacturing: Food, Beverages, Tobacco	Construction	Trade, Transport and Communication Services	Other Market Services	Non-Market Services	Institutional Sectors, Total
		1	2	3	4	5	6	7	8	9	10	11	12	13
		Million Deutsche Marks												
1	Intermediate Consumption	46 775	44 305	133 060	123 459	133 281	66 084	85 438	102 357	86 568	92 367	112 114	123 742	1 149 550
2	Gross Value Added	29 525	42 580	82 142	33 134	93 009	61 663	57 077	47 966	64 115	163 591	233 210	141 048	1 049 060
3	Consumption of Fixed Capital	6 429	8 910	10 807	4 177	9 283	4 971	4 861	4 890	4 035	18 510	32 842	7 315	117 030
4	Production Taxes less Subsidies	62	6 838	20 426	2 933	4 294	5 746	6 141	16 049	8 602	7 324	15 144	181	93 740
5	Compensation of Employees	4 731	16 858	40 407	21 497	70 330	44 234	36 370	18 133	38 774	97 597	59 867	133 552	582 350
6	Operating Surplus	18 303	9 974	10 502	4 527	9 102	6 712	9 705	8 894	12 704	40 160	125 357	-	255 940
7	Gross Output	76 300	86 885	215 202	156 593	226 290	127 747	142 515	150 323	150 683	255 958	345 324	264 790	2 198 610
		Percent of Gross Output												
8	Intermediate Consumption	61,3	51,0	61,8	78,8	58,9	51,7	60,0	68,1	57,5	36,1	32,5	46,7	52,3
9	Gross Value Added	38,7	49,0	38,2	21,2	41,1	48,3	40,0	31,9	42,5	63,9	67,5	53,3	47,7
10	Consumption of Fixed Capital	8,4	10,3	5,0	2,7	4,1	3,9	3,4	3,3	2,7	7,2	9,5	2,8	5,3
11	Production Taxes less Subsidies	0,1	7,8	9,5	1,9	1,9	4,5	4,4	10,6	5,7	2,9	4,4	0,1	4,3
12	Compensation of Employees	6,2	19,4	18,8	13,7	31,1	34,6	25,5	12,1	25,7	38,1	17,3	50,4	26,5
13	Operating Surplus	24,0	11,5	4,9	2,9	4,0	5,3	6,8	5,9	8,4	15,7	36,3	-	11,6
14	Gross Output	100,0	100,0	100,0	100,0	100,0	100,0	100,0	100,0	100,0	100,0	100,0	100,0	100,0

1) The branches consist of a grouping of homogeneous production units (cf. ESA, No. 268).-For a comparison of the classification of the branches with the ISIC cf annex.

Table 4: Compensation of Employees 1975 by Commodity Groups and Institutional Sectors

Million Deutsche Marks

Ser. No.	Institutional Sector 1) / Commodity Group	Agricul-ture, Foresty, Fishing	Electri-city, Gas and Water; Mining	Manufacturing: Chemicals, Petroleum, Plastic and Non-Metallic Mineral Products; Quarrying	Manufacturing: Basic Metals	Manufacturing: Machinery except Electrical; Transport Equipment	Manufacturing: Electrical Machinery, Fabricated Metal Products n.e.c.	Manufacturing: Textiles, Leather, Wood, Paper and Products	Manufacturing: Food, Beverages, Tobacco	Construc-tion	Trade, Transport and Communica-tion Services	Other Market Services	Non-Market Services	Institu-tional Sectors, Total
		1	2	3	4	5	6	7	8	9	10	11	12	13
1	Agricultural, Foresty and Fishing Prod.	4 731	-	-	-	-	-	-	-	-	-	-	-	4 731
2	Electricity, Gas, Water, Mining Prod.	-	15 524	393	619	25	9	67	14	104	103	-	-	16 858
3	Chem., Petr. Plastic and Non-metallic Prod.	-	169	37 656	338	204	417	813	49	342	419	-	-	40 407
4	Basic Metals	-	106	107	18 810	1 736	575	7	-	-	156	-	-	21 497
5	Machinery except Electr.; Transport equipment	10	112	325	1 874	61 961	1 772	89	8	2 939	1 240	-	-	70 330
6	Electr. Machinery, Fabr. Metal Prod. n.e.c.	1	284	644	916	1 191	40 407	177	-	-	614	-	-	44 234
7	Text. Leather, Wood, Paper and Prod.	-	-	442	-	228	312	33 394	67	1 171	471	285	-	36 370
8	Food, Beverages, Tobacco	107	-	58	-	10	14	28	16 999	-	782	135	-	18 133
9	Construction	31	269	193	75	1 163	146	30	30	36 441	338	-	58	38 774
10	Trade, Transport and Communication Services	72	512	1 256	501	1 889	1 229	760	869	333	89 812	364	-	97 597
11	Other Market Services	58	44	56	87	983	729	355	244	420	1 425	55 466	-	59 867
12	Non-Market Services	-	-	-	-	-	-	-	-	-	-	-	133 552	133 552
13	Commodity Groups, Total	5 010	17 020	41 130	23 220	69 390	45 610	35 720	18 280	41 750	95 360	56 250	133 610	582 350

1) The institutional sector consists of a grouping of enterprises etc.-For a comparison of the classification of the institutional sectors with the ISIC cf annex.

tion performed on this level entails larger deviations in the case of some branches, but generally do not exceed 25 % of the institutional data before conversion.

The transition of the inputs from institutional to commodity classification is accomplished <u>for each type of input</u> by means of special transition matrices. These transition matrices allocate the inputs of institutional sectors to the commodities produced in these sectors. Table 4 shows the transition of the compensation of employees for 12 highly aggregated sectors. The data refer to 1975. The totals of the columns correspond to the row "compensation of employees" in Table 1, the totals of the rows correspond to the respective row in Table 3. An item in the table is the compensation of employees in million Deutsche marks paid to the employees in an institutional sector (column classification) for producing a specific commodity group (row classification).

The transition matrices set up for each type of input are computed in three steps:

a) In some cases, it is possible to allocate a part of the inputs of an institutional sector directly to specific commodity groups. This for instance applies to individual types of subsidies.

b) The remaining data for the institutional sectors are transmitted by means of the assumption of the "commodity technology". This assumption seemed to be the most plausible. The application of the assumption of the "industry technology" with regard to by-products is not necessary because in the German input-output table the by-products remain in a first step with the commodities they are connected with in the production process. In a subsequent step they enter as intermediate inputs in those branches to which they belong according to the commodity classification.

   The use of the commodity technology assumption makes it possible to set up a special transition matrix for each type of input on the basis of the following table pattern:

	Sector	$\sum$
Commodity group	$a_{k1}v_{11}$ .... $a_{k1}v_{1m}$ . . . $a_{kn}v_{n1}$ .... $a_{kn}v_{nm}$	$a_{k1}q_1$ . . . $a_{kn}q_n$
$\sum$	u_{k1} .... u_{km}	

u_{k1} , ..., u_{km} are the given values of the kth type of input in m institutional sectors, q_1 , ... q_n the gross outputs of the n branches, a_{k1} ... a_{kn} the unknown input coefficients for the kth type of input and v_{11} ......, v_{nm} the elements of the make matrix V. The input coefficients of a row are equal: In accordance with the commodity technology assumption, the production of a commodity group has the same input structure in each sector in which this commodity group is being produced. If the number of rows is equal to the number of columns, the input coefficients can be determined by means of the solution of a system of equations[33]:

$$
\begin{aligned}
u_{k1} &= a_{k1}\, v_{11} + \dots + a_{kn}\, v_{n1} \\
&\;\;\vdots \qquad\qquad\qquad\quad \vdots \\
u_{km} &= a_{k1}\, v_{1m} + \dots + a_{kn}\, v_{nm}
\end{aligned} \tag{1}
$$

Written in matrix algebra:

$$u_k = a_k\, V' \tag{2}$$

u_k is the kth row of the absorption matrix, a_k the kth row of the (unknown) input coefficient matrix of the input-output table, V' the (transposed) make matrix.

$$a_k = u_k\, (V')^{-1} \tag{3}$$

c) The data on institutional sectors directly allocated to the commodity groups and the institutional data allocated to the commodity groups by means of the commodity technology assumption are added to a transition matrix for the respective type of input, which shows as column totals the values before transition and as row totals the result of the transition. If necessary, this table will be corrected in a third step. Of course, the given values (column totals) remain unchanged during the correction procedure. Corrections will in particular be necessary if the general assumption of commodity technology does not seem to be justified for certain items of the table. This, for instance, will be possible if the composition of the commodities of a table item deviates to a larger degree from the average structure of the respective commodity groups. Furthermore, the corrections take into account - if available - information on the input structures of branches defined by commodities.

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33) Cf SNA (1968), p. 49, and C. Stahmer, op.cit.

Concluding, it should be mentioned that it is possible to reverse the transition procedure. By means of the special transition matrices the data of the commodity by commodity tables can be converted to the institutional classification[34]. While in the case of the transition described the institutional data are allocated to the commodities according to the columns of the transition matrix, it is also possible to distribute data of the commodity by commodity table to institutional sectors by means of the rows of the transition matrix. This reverse projection of input-output data can be applied for input-output analysis and deflation: with regard to many questions, it is of interest to convert the results of input-output analysis using commodity by commodity tables to an institutional classification, in order to determine the impact on institutional sectors. On the other hand the results of the deflation of input-output tables can provide important information for price adjustments of gross output, intermediate consumption and value added of institutional sectors[35]. The price indices, which initially are predominantly available in a commodity classification, can be converted with the transition model to an institutional classification. It is envisaged to deflate the gross value added of institutional sectors largely with price indices which have been derived from the input-output tables in the described manner.

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34) Cf United Nations, Input-Output Tables and Analysis, op.cit. p. 35 f.- 35) See W. Neubauer, Über Typen gesamtwirtschaftlicher Verflechtungsdarstellungen und ihnen adäquate Deflationierungsmethoden, in: U.P. Reich, C. Stahmer (Eds), Input-Output-Rechnung: Energiemodelle und Methoden der Preisbereinigung, 1981.

Annex

Comparison of the sector classification (cf tables 1-4) with the International Standard Industrial Classification (ISIC)

Sector	ISIC - No.
Agriculture, forestry, fishing	1
Electricity, gas and water; mining	ex 2, 4
Manufacturing	
Chemicals, petroleum, plastic and non-metallic mineral products; quarrying	ex 2, 35, 36
Basic metals	37
Machinery except electrical; transport equipment	382, 384
Electrical machinery, fabricated metal products n.e.c.	381, 383, 385, 39
Textiles, leather, wood, paper and products	32 - 34
Food, beverages, tobacco	31
Construction	5
Trade, transport and communication services	6, 7
Other market services	8, ex 9
Non-market services	ex 9

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TWO METHODS OF ELABORATING "INPUT-OUTPUT" TABLES

by

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The construction of a commodity x commodity "Input-Output" table is more akin to a modelisation than to a statistical description of inter-industry trade. Two methods of contruction are proposed ; the first, or algebraic method, is macroeconomic. It consists of an algebraic computation of the technical coefficients in each industry based on those in the sectors. On the contrary, the second, or econometric method, is microeconomic : it leads to an econometric estimate of these same industry-technical coefficients from individual-firm data.

Both methods permit the construction of income statements per industry.

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Compilation of Input-Output Tables. Edited by J. Skolka.

INTRODUCTION

Representation of inter-industry exchanges by means of an "input-output" table rests on the "branch" concept. A branch of activity is defined (both in the national accounts and conventional input-output models) by reference to a nomenclature of commodities ; thus, in the reference handbook of the French SECN* [1976] a branch is a "homogeneous group of production units... producing, in theory (1), all the goods and services described in one item (of the nomenclature of commodities) and those commodities alone". Now, reality, be it technical, accounting or statistical, is not that simple : the general rule for production units is diversification, at any somewhat detailed nomenclature level. There can therefore be no exact correspondence between branches of activity and production units or a group of them, such as statistical sources present them - generally firms, at best establishments.

Furthermore allocation of input or primary factors to the goods and services produced cannot be achieved directly with the available accounting data, it is even harder to break down the vertically integrated or highly diversified activities, joint productions and fatal commodities into their productive components. They cannot be actually dissociated technically from the commodity to which they are linked.

A commodity x commodity I-O table cannot be therefore constructed from statistical sources by simple aggregation. Such construction compels to resort to assumptions related to the nature of the productive processes involved. Thus it is more akin to a modelisation of reality than to a mere neutral transcription of economic flows, supposedly the objective national accounts should strive to approach.

The two approaches are sufficiently different in nature to enable the Offices of Statistics in many countries to conform to the UNO system of national accounts without establishing commodity x commodity tables. Instead, they construct and publish tables which, on the one hand, gather intermediate consumption, and, on the other hand, the productions of industries broken down into commodities. The data are obtained directly from analysis of surveys and reference lists drawn up by establishments (as it is generally the case), or by firms. The task of constructing

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* SECN : Système Elargi de Comptabilité Nationale (Extended System of National Accounts).

(1) the restrictive "in theory" refers to the few fatal commodities dealt with by the SECN, which transfers outputs alone.

commodity x commodity input-output tables is then left to economists who are able to adopt assumptions on productive process consistent with the object of their studies.

*

* *

Both of the methods of constructing input-output tables proposed herein develop and formalize the technological assumptions which enable us to go from the inputs of firms or industries up to the outputs of the branches, and the way in which this allocation is carried out. Both originate in the statistical sources of the firms, whether they are aggregated in industries or not.

The first method -- hereafter referred to as "the algebraic method" - is macroeconomic : it consists in breaking down the inputs of industries into their various activities on the basis of different assumptions on their technologies. Stemming directly from the work of T. GIGANTES [1970] and the work done in the preparation of the UNO system of national accounts [1970], it was used by E.G. ARMSTRONG [1975] to construct a U.K. I.O. table for the year 1963.

The second method - the econometric method - is both probabilistic and microeconomic : it consists of an econometric estimate of the technical coefficients of the branches, directly from individual data concerning the firms. It originates from the works of ARKHIPOFF and CHAUMONT [1975], used in the Cameroons, G.J.A. MENSIK [1974] in the Netherlands, OSAKI [1971] and GERKING [1976].

The two statistical sources used are favorite national accounts sources : the tax returns of firms to the B.I.C.*, and the replies of the firms to the E.A.E.** both covering the year 1975 and conducted by the Ministry of Industry.(1)

On one hand, these two sources furnish the general profit and loss statements of the firms, and breakdowns of their sales and purchases into activities or commodities on the other hand. In the nomenclature of activities and commodites (NAP-1973) (2), at level 600, for sales, at a level close to level 40 of this same nomenclature for purchases.

* B.I.C. : Bénéfices Industriels et Commerciaux (Industrial and Trade Profits).
** E.A.E. : Enquête Annuelle d'Entreprises (Firms' Annual Survey).
(1) We rejected from "industry" the agricultural and food industries and building and civil and agricultural engineering, for which the questionnaires of the annual survey differ.
(2) Nomenclature d'activités et de produits (NAP) 1973.

The "purchases" questionnaire of the EAE (Firms' Annual Survey) is only completed by firms employing more than 100 persons. It was therefore amongst the 3 000 or so firms which completed this questionnaire that the 705 firms of the sampling used were chosen. We do not describe herein the operations carried out on the basis of data, mainly to translate private accounting concepts into their correspondents in national accounting. The notion of intermediate production and consumption is mostly concerned because of the lack of data related to integrated productions and inventories by commodities. All these corrections can be the source of errors in data, errors which can be taken into account to a certain extent as we explain further on.

1 - The algebraic method

1.1. The problem

To begin with two tables are required. One breaks down the intermediate consumption of industries by commodity. The other breaks down the production of industries into commodity . Consequently how to construct a commodity x commodity table of intermediary consumptions, i.e. a table crossing branches of industries and commodities (" branches" being defined hereafter as in the introduction) by making assumptions on the technologies involved in the different activities ?

In other words, if in the initial table we consider intermediate consumptions by commodities in one industry (listed in one column), we must remove the inputs corresponding to the industry's subsidiary activities, and add the inputs corresponding to its principal activity when it is carried out in other industries, in order to obtain the intermediate consumptions of the corresponding branch.

Definitions and notations

Following the accounting framework set by Richard Stone and adopted by the U.N. for their system of national accounts, the different exchanges on goods and services are :

DIAGRAM 1

	Commodities	Industries	Final demand	Totals
Commodities		U	e	q
Industries	V			g
Primary inputs		y'	////////////	
TOTALS	q'	g'		

Matrix U groups the intermediate consumptions of the industries ; matrix V their productions, both being broken down into commodities. The vectors g and q are respectively the productions of industries and of commodities.

It will be noted that the y primary inputs matrix may be included in the U intermediate consumptions matrix. If the utilization of primary inputs is represented by items taken from accounts (wages, gross operating surplus, etc...) construction of the I-O table from this U matrix will include the computation of income accounts by branches.

From these matrices in amounts, we define three other matrices of coefficients or proportions :

$B = U \hat{g}^{-1}$ Matrix of industry input coefficients where $\hat{g}$ is a matrix having as its main diagonal the elements of the g vector, and zeros everywhere else.

$D = V \hat{q}^{-1}$ Matrix of market shares of industries.

$C = V' \hat{g}^{-1}$ Matrix of industry product-mixes, describing the commodity shares in the production of each industry ; V' designates the V transpose.

Finally, the letter A will designate the matrix of the branches' technical coefficients which are to be calculated.

The elements of the four preceding matrices are expressed in percentages : their sums (in columns) are therefore all equal to 100.

1.2 The technological assumptions

The branch production functions are of the conventional Leontief type, with no substitution between factors and constant returns to scale. A technology can be represented by a set of input coefficients (among them eventual primary inputs).

In the connection between technology and branch (one branch producing one commodity and only one) new assumptions are introduced :

i) technology is attached to the production sector (industry technology model),

ii) technology is attached to the commodity : thus we go back to Leontief's assumption (commodity technology model).

But this method allows to mix the assumptions : one single commodity can be processed according to the different technology assumptions depending on the industries in which it is produced. Thus technical differences, and, to some extent, heterogeneity of commodities can be taken into account.

a. The industry technology assumption.

Here all the commodities elaborated by one industry are elaborated according to the same technology. Thus the production of one single commodity may correspond to different intermediate consumption structures depending which industry processes it . The input structure of one branch is then a linear combination of the structures of the industries, weighted by their respective market shares in the production of the related commodity. Thus, with the above-defined notations, the matrix of the technical coefficients of the branches is written : $A = BD$.

It is to be noted that the matrices may be rectangular, provided that their dimensions are compatible. The nomenclatures of industries, branches and commodities may therefore differ : it may indeed be of interest to consider more detailed levels for commodities than for branches, and for branches than for industries.

To assume that technologies are attached to industries is to assume that the "technical coefficients" of the industries, grouped in matrix B, indeed describe technical relations, and are therefore stable, whatever the production levels of the industries, and whatever the "commodity share" in the production of the industries.

The technological assumption can then be formally written :

B stable, $\forall$ productions of industries, and $\forall$ C matrix of commodity shares in these productions of industries - and therefore for any distribution of the productions of commodities amongst the industries, represented by matrix $V = C' \hat{g}$.

b. The commodity technology assumption.

A commodity is always elaborated according to one and the same technology, whatever industry produces it.

In this case, the intermediate consumption structures of industries are linear combinations of those branches in which they carry out an activity, weighted by the share of each of these branches in their total production.

With the notations defined above, the relation is expressed with the help of matrix C of the commodity shares in the production of industries :

$$B = AC$$

Whence, with C being square and invertible :

$$A = BC^{-1}$$

The invertibility of C is ensured when, in all its columns, the diagonal element exceeds the sum of the other elements, i. e. when the main activity of each industry represents more than half of its production, which in practice is always the case.

In other words, one assumes that there are branch technical coefficients which are stable whatever the production level of the branches, and whatever the market shares of the industries :

A stable , $\forall$ productions of commodities , $\forall$ D market shares of the industries in the production of commodities, (and hence for any distribution of commodity productions amongst the industries, represented by matrix $V = D\hat{q}$).

c. <u>The hybrid technology assumption</u>.

Whatever their validity in other respects (later developed), these two technology assumptions appear very rigid, since in every case one assumes that all productions involve the same type of technology.

So we can think of combining the two assumptions, by choosing the most relevant type of technology for each production. Moreover, so as to counter the effects of aggregation and the flaws of the nomenclature, the production of a single commodity (in terms of the nomenclature) can be split into two components, each one receiving a different technology assumption.

The "hybrid" or "mixed" technology thus obtained appears to be more flexible (and also more realistic) than the preceding ones.

To do this, we are prompted to distinguish between productions to which the commodity technology assumption applies (hereafter designated by index 1) and those which are elaborated according to an industry technology (designated by index 2). We then have :

$$V = V_1 + V_2 \qquad g = g_1 + g_2 \qquad q = q_1 + q_2$$

Intermediate consumptions of commodities can be written, applying the same notation to the technical coefficient matrices :

$$A_1\, q_1 + A_2\, q_2$$

The problem then is finding matrix A, so that :

$$A\, q = A_1\, q_1 + A_2\, q_2$$

The problem can be solved easily, with the help of matrices which are analogous to matrices C and D defined previously. Thus, if the two matrices are defined :

$$C_1 = V_1' \quad \hat{g}^{-1} \text{ and } D_2^* = V_2\ \hat{q}_2^{-1}$$

We have : $Aq = BC_1^{-1}\ \ q_1 + BD_2^*\, q_2$

By defining a matrix D_2 such that $D_2 = V_2\ \hat{q}^{-1}$, we have : $D_2^* q_2 = D_2 q$

Besides, q_2 vector can be written : $q_2 = \widehat{D_2' iq}$ where i is

a unit vector of suitable dimension. Thus $Aq = BC_1^{-1}(q - q_2) + BD_2 q$
and

$$A = B \left[C_1^{-1} \; (I - \widehat{D_2' i}) + D_2 \right]$$

This expression, given by A.G. Amstrong [1975] , is used when applying the method to the French data .

1.3. How to choose technology assumptions ?

The assumption of a technology linked to the commodity, in fact the Leontief model assumption, appears to be the best from a technological point of view : the nature and proportions of inputs and production factors used in a productive process are indeed linked more to the physical nature of the commodity than to the main activity of the industry or the firm where it is manufactured.

However this line of reasoning, though it prevails on a microeconomic level, can be challenged at the macroeconomic level. A "commodity" is then an item in the nomenclature which can group commodities elaborated according to techniques which differ, even in their very nature. One single commodity (in the microeconomic sense) may even be elaborated by using competing and different techniques. On the contrary, commodities which are alike and elaborated with the same technology may be classified under different items in the nomenclature, due for example to the way in which their production is organized or the specific character of their use.

Thus, the technology attached to the commodity is a weighted average of all the techniques used for the elaboration of the different "elementary commodities" grouped in the nomenclature. Under these conditions, the commodity technology assumption amounts to postulate that the production of a commodity is carried out (in every industry involved) according to this same average technique. Therefore , the composition of the "elementary" commodities and the assortment of techniques used are the same in all industries. Naturally, this assumption is a very strong one, the stronger the more aggregated is the nomenclature.

The industry technology assumption is similar to the commodity technology one, except for an inversion of the roles played by industries and branches. The technical homogeneity now concerns the industries, and no more the commodities.

But the technological homogeneity of industries also appears to be a very strong assumption, particularly for diversified industries : all the activities are presumed to have the same input structure as the industry as a whole. This structure does not depend upon the respective shares of the different commodities in the production of the industry. Indeed we may suppose that, in certain cases, technology is intrinsic to the industry, whatever it produces, because of its equipment or the type of manpower it employs... but this is obviously not the usual situation.

The industry technology assumption can nonetheless be applied, when the industries are not too highly diversified : this is the case for commodities which are listed under an item of the nomenclature which does not correspond to their true production technique.

The commodity technology assumption, on the other hand, is well suited to the main productions of industries, as well as to most of their "ordinary" secondary productions, i. e. other than fatal and mixed commodities.

In both cases, the assumptions give a realistic picture of the technologies actually used only inasfar as the nomenclature is "sufficiently" detailed. But a nomenclature to which these assumptions might apply strictly would be too detailed to be of any use. When commodities are manufactured by several productive processes simultaneously, there is no relevant nomenclature based on a classification by commodities, no matter how detailed.

Finally, it will be noted that it is to some extent possible to dissociate the case of intermediate consumptions of goods and services, which depend upon the technique used, from that of primary factors, which we can assume to depend more upon the firm, hence upon the industry. The industry technology assumption, where "technology" designates the utilisation of production factors, would then apply properly. However, it is known that labour and capital productivities , wage rates, indirect tax rates, and all factors involved in the operating account in the national accounts sense, may vary from one activity to another within the same firm and thus limitates the validity of the assumption.

1.4. Consequences of the assumptions on the use of Input-Output Tables

So far assumptions have been selected in order to obtain an I-O table which would be the best possible description of the exchanges that actually took place between branches during the period referred to. But assumptions chosen for the construction of an I-O table do have consequences on the way it is used, for example, within the framework of input-output models.

Thus, the first assumption in the use of I-O tables is the unicity and homogeneity of production techniques. The requirements of the assumption are not met by either of the two technology assumptions. If in theory the commodity technology assumption meets them, the necessarily aggregated level of the branches commodities invalidates it in practice. As for the industry technology assumption, it presupposes that the industries, but not the branches, are homogeneous as far as production techniques are concerned.

The second assumption is the stability of the technical coefficients of the branches when their production levels vary.

The industry technology assumption does not in itself secure this stability. It is secured (as can be seen in the matrix A expression of the technical coefficients of the branches : A = BD) only by the stability of the market shares of industries in the production of commodities, grouped in matrix D (matrix B of the input coefficients of industries is presumed to be stable, since they represent technologies of productions).

Use of the I-O table therefore necessitates an additional assumption (with respect to its construction alone), but in most cases it does not constitute much of a constraint : generally input-output models are used in variants which are not far remote from the situation of reference, and in which market shares can not vary but little.

In the commodity technology assumption, no additional assumption is needed to go from the construction to the use of the I-O table. The stability of the technical coefficients of branches is an integral part of the technological assumption. Then, industries only play an institutional role, exerting no influence on technologies.

When the I-O table is used, the sharing out of productions according to the type of technology attributed to them is no longer observed a posteriori as it is during construction, but a priori assumed. The advantage of various formulations of the input coefficient of branches matrix then appears : depending on whether one assumes the stability of the commodity shares, it is more advantageous to compute matrices which are analogous to D or analogous to C in the expression of A[(1)].

1.5 Application of the algebraic method.

a. The tables

From the individual data of firms in a 40 commodities nomenclature, we computed by aggregation tables of the intermediate productions and consumptions broken down into commodities. These tables comprise 21 industries, 21 commodities and 35 inputs : 27 items of intermediate consumption, 6 items of the income statements (in the national accounts sense), 2 production factors (labor and capital). These are the tables designated by U and V in what precedes.

From there, matrices B, C and D were calculated :

B : Matrix of Industry input coefficients (matrix 35 x 21),

C : Matrix of Industry commodity shares,

D : Matrix of Industry market shares (21 x 21 matrixes).

These three matrices are to be found in the following pages (tables 1 to 3).

Finally, three technical coefficient matrices were elaborated, each of them corresponding to a technology assumption : industry, or hybrid technology. Only the latter is reproduced here (table 4).

b. Results

The input structures of branches most often resemble those of corresponding industries.

We note this in comparing tables 1 and 4. And indeed, for the

(1) It will be noted that the methodology described here also permits construction of "industry x industry" input-output tables.
Certain countries construct such tables, which in fact are provided for by the United Nations system. The problem in that case is going from a demand expressed in terms of commodities over to a demand for industries.

40 commodities of the nomenclature used here, on the one hand the industries are "rather" pure, and, on the other hand, the productions of commodities are "rather" concentrated. In other words, the matrices C and D are broadly diagonal (see tables 2 and 3).

The technical coefficients of industries (b_{ij}) and of branches (a_{ij}) being linked, in the case of industry technology assumption, by :

$$a_{ij} = \sum_k b_{ik} \ d_{kj}$$

in which d_{kj} is the extent to which the commodity j is elaborated by industry k. In the case of commodity technology assumption, by :

$$b_{ij} = \sum_k a_{ik} \ c_{kj}$$

in which c_{kj} is the share of branch k in the production of industry j. It follows therefrom that the technical coefficients of a branch are all the closer to those of the corresponding industry as :

- the market share of the industry in the production of the branch is closer to 1 (industry technology assumption) ;
- the share of the commodity in the production of the industry is closer to 1, i. e. as the industry is less diversified (commodity technology assumption).

And, on the contrary, for the activity "Foundry, working of metals" which corresponds at the same time to the most diversified industry and to the commodity the production of which is the least concentrated, we observe rather large differences between the inputs structure of the branch and that of the industry.

However, were the nomenclature at a more detailed level, would the industries be more diversified. Going from industries over to branches would modify input structures more profoundly.

... <u>but there can be relatively important discrepancies between branches and industries, for certain technical coefficients</u>...

Indeed, one notes casual discrepancies which may be great, for certain specific technical coefficients, and for industries whose input structures are slightly changed when we go from industries over to branches.

These discrepancies may stem from secondary activities of one industry having input structures which differ greatly from those of the industry itself and hence of its principal activity (commodity technology). It may also come from various industries producing one and the same commodity and presenting different input structures (industry technology).

... and "outlying" technical coefficients may even appear : e. g. negative coefficients when using the commodity technology...

Outliers in input coefficients for branches appear for different reasons : aggregation level of the nomenclature ; definition of the branches on the basis of commodities alone, and not of the commodity + technology tandem ; finally, assumptions on the forms of production functions (too schematic).

If the negative coefficients which appear when using the commodity technology assumption constitute quite visible inconsistencies, it is probable that other outliers, yet positive, will also appear, though they are hard to detect. Indeed, we have no a priori reference, and the comparison between coefficients of branches and coefficients of industries rapidly reaches a limit : large discrepancies may be quite legitimate, justified by differences in technologies, as we have seen above : hence the necessity of using other sources - commodity statistics, technological data - to avoid such errors.

One formulation, proposed by C. ALMON [1970] , shows how, in the case of a commodity technology, one can go from intermediate consumptions of industries over to those of branches.

In the formulation, we can plainly see how negative technical coefficients can then appear for a branch : all what is needed is that the corresponding industry have secondary activities which use - depending on the technique attributed to them - inputs which are little used or not used by the industry itself.

The crux of the problem raised by the appearance of outliers (negative or ortherwise) is that they show at evidence a faulty representation of technologies : when an industry does not consume the input which one of its accessory activities "should" consume (in conformity with the technology of its branch) it means that this activity, exercised in the industry concerned, has not the technology of the same activity exercised in other industries. Therefore the solution goes through an additional disaggregation and identification of the different techniques used concurrently in each activity.

This is what is demonstrated by the example of the activity "Rubber, plastic" taken up again in greater detail in annex I.

Indeed, the "Rubber, plastic" industry produces, as a secondary activity, specific equipment for automobiles, which is classified in the nomenclature amongst the commodities of the "Land transport equipment" branch. Use of the commodity technology assumption for this production, though it represents only 2.8% of the industry's total production, brings about the appearance of a negative coefficient for the "Land transport equipment" input of the "Rubber, plastic" branch.

For the "Land transport equipment" industry (and hence branch) shows heavy intra-consumption, resulting from the incorporation of the equipment in the manufacture of the automobiles themselves : the input coefficient for the industry is 27.1% and becomes 28.1% for the branch if the commodity technology assumption is used. On the contrary, the "Rubber, plastic" industry consumes no commodities listed in the "Land transport equipment" branch : therefore a negative technical coefficient (- 0,9%) appears for that commodity when the "Automobile" activity is removed from the "Rubber, plastic" industry to arrive at the corresponding branch.

... Coefficients which a "hybrid technology" assumption can eleminate.

Formal methods have been proposed to eliminate negative coefficients most of these methods consist in cancelling them and balancing the table again by various means, iterative or not. Thus all the coefficients are modified thereby.

But such methods only mask the problem without going at its root. TO be sure, they do present the advantage of being computerized and practically automated. Furthermore, all the negative coefficients obtained in the application, described here, of the commodity technology assumption were, in absolute value, below 2%, most of them being below 1%. Under these conditions, it is admissible to rebalance the table after cancelling the negative coefficients, which modifies the other coefficients only marginally.

Nevertheless it remains true that it is the identification of the technologies actually used and their representation with different technological assumptions, which are involved here. The ideal solution would consist in identifying the actual technologies used in the accessory activities of the industries which

cause the appearance of negative coefficients, and more generally of "outliers".

Strictly speaking such a solution would necessitate the study, at a very detailed level of the nomenclature (e. g. level 600 or even a much finer level), of all these activities. Failing this, one may attribute to them the technology of a neighboring activity, either in their industry of origin or in the branch to which they are attached ; (thus, in our example, the technology of one or several sub-branches of the "Rubber, plastic" branch or the "Automobile" branch).

Having adopted in this study the "level 40" of the Nomenclature d'Activités et de Produits (NAP), we have chosen a practicable solution which needs neither additional disaggregations at level 90 and 600, nor, a fortiori, a search for specific information.

It has thus been assumed, as far as the preceding example is concerned, that the specific equipment production activity for "Automobile" by the "Rubber, plastic" industry belonged to the technology of that industry as a whole, at "level 40". The negative technical coefficient, corresponding to the intermediate consumption of land transport equipment, is then cancelled.

More generally, the same industry technology assumption was used for all the secondary productions when they led to negative coefficients exceding 0.1% in absolute value within the commodity technology assumption. Thus it is a hybrid technology assumption which is called upon essentially for pragmatic and pedagogical purposes. The results are shown in table 4.

The input structures thus obtained for branches are not fundamentally different from those of the industries, nor from those obtained with an industry or commodity technology. In fact they are most often intermediary. It should be noted that only slight negative coefficients remain, and we can get rid of them via one of the formal methods mentioned above without strong modifications of the other coefficients.

Conversely, certain technical coefficients are rather sensitive to the technologies chosen for the productions to which they correspond : this confirms that these choices must be founded on precise and detailed studies of technologies.

Finally, if the magnitude of the coefficients yielded by the input-output table of the national accounts are retained, rather sizeable discrepancies may appear ; no study has been made to identify the causes of the discrepancies. We may surmise, however, that most of them are due to the fact that the national accounts I-O tables try to take into account integrated productions which do not appear in the accounting sources of the firms.

TABLE 1 : Industry x commodity input matrix.

Products \ Industries	T 04 Mineral Solid Fuels	T 05 Petroleum & natural gas	T 06 Electricity, gas water	T 07 Iron and Steel	T 08 non ferrous metals	T 09 Construction materials	T 10 Glass	T 11 Basic chemicals	T 13 foundry & metal working	T 21 paper & paper board
T01. Agriculture						0,07		0,14		9,02
T02. 03. Food & Agricultural industries								1,20		0,24
T04. Solid Mineral fuels	76,16	0,03	2,98	9,54	2,01	0,99	0,01	0,68	0,29	0,06
T06. Electricity, gas, water		0,25	0,60	3,60	7,19	4,95	3,94	3,84	1,91	2,08
T12. Parachemical			0,12	0,43	0,25	0,69	0,10	0,22	1,02	0,46
T05. Petroleum products		63,67	15,86	1,63	1,84	7,83	3,64	12,54	0,56	3,04
T07. Iron & steel			0,30	22,43	0,31	2,12	0,85	0,03	15,56	
T08. non ferrous metals		0,01	1,29	4,76	40,17	0,28	0,55	0,78	4,10	0,29
T13. foundry & metal working		0,02	0,67	2,80	0,62	0,28	1,21	0,43	3,51	0,81
T14. mechanical equipment		0,30	0,94	3,58	1,09	2,77	1,33	1,99	0,87	1,27
T15. electrical equipment		0,02	1,50	0,76	0,62	0,33			0,25	
T16. land transport equipment				0,26		0,01			1,07	
T17. Ship building & Aircraft									0,13	
T10. Glass							1,63	0,02	0,01	
T11. Chemicals		0,52	0,06	0,51	3,34	1,75	3.43	23,44	0,50	5,47
T18. Textile & clothes			0,05	0,14		0,38	0,01		0,05	1,04
T19. Leather & shoes			0,02	0,01		0,02			0,02	
T20. Furniture			0,05	0,15		0,06	0,12	0,01	0,02	0,06
T21. paper & paper board			0,07	0,01	0,04	0,24			0,07	26,70
T23. rubber, plastic			0,05	0,08	0,73	0,44	0,15	0,01	0,30	0,30
T09. construction materials			0,12	1,72	0,85	8,74	6,16	7,04	0,57	0,19
packing		0,23		0,27	0,47	2,82	6,74	1,18	0,78	0,94
unidentified		0,02	4,47	2,65	2,10	0,04	0,45	0,50	1,64	1,43
sub constructing	11,73	1,51	4,24	3,46	2,53	1,43	3,02	3,29	5,52	0,35
sub processing		3,78	9,90	7,02	6,16	7,81	8,44	10,05	7,59	4,94
transportation	5,40	5,16	1,84	5,08	5,80	8,56	8,39	6,28	4,84	4,67
working expenses	0,14	0,67	1,35	1,10	1,26	1,66	2,10	1,53	2,03	1,54
value added	**6,56**	**23,81**	**53,52**	**28,00**	**22,60**	**45,74**	**47,72**	**24,80**	**37,96**	**49,44**
net wages	0,02	2,73	15,53	19,82	18,00	22,31	34,24	18,67	21,85	26,99
employers contributions		1,03	8,75	7,39	6,83	7,86	11,74	6,94	7,52	8,62
licence, wage taxes	0,18	0,17	2,87	0,94	0,75	1,07	1,01	0,98	0,88	0,57
turnover taxes			0,04			0,44	0,01		0,07	0,04
others taxes	0,10	14,88	1,90	0,44	0,64	0,52	0,39	0,58	0,47	0,50
gross entrepreneurial income	6,26	5,00	24,43	− 0,59	− 3,62	13,54	0,33	− 2,37	7,17	12,72
Total	**100,00**	**100,00**	**100,00**	**100,00**	**100,00**	**100,00**	**100,00**	**100,00**	**100,00**	**100,00**
Salaries	0,7	0,5	3,8	5,3	4,1	5,6	8,7	4,1	6,7	5,1
Capital	77,0	32,5	294,4	98,4	79,5	108,3	74,9	89,1	44,1	65,8

Products \ Industries	T 23 Rubber, plastic	T 14 Mechanical equipment	T 15 A Electrical equipment	T 17 Ship building & Aircraft	T 15 B Household Electrical equipment	T 16 Land Transport equipment	T 12 Parachemicals & pharmaceutics	T 18 Textile & clothes	T 19 Leather and shoes	T 20 Furniture	T 22 Printing & publishing
T01. Agriculture	0,02	0,01					0,41	0,35	0,15	10,35	
T02. 03. Food & Agricultural industries	0,08						1,01		5,33	0,57	
T04. Solid Mineral fuels	0,23	0,08	0,01	0,01	0,06	0,12	0,03	0,15	0,02	0,01	0,01
T06. Electricity, gas, water	1,94	0,85	0,71	0,54	0,81	0,88	0,94	1,36	0,84	1,50	0,81
T12. Parachemical	0,32	0,36	0,24	0,30	1,43	0,64	1,73	0,45	0,74	5,21	1,09
T05. Petroleum products	1,54	0,50	0,18	0,33	0,10	0,46	0,54	0,74	0,52	0,61	0,04
T07. Iron & steel	3,90	10,35	2,13	4,60	4,76	6,93	0,11			1,69	
T08. non ferrous metals	0,55	0,96	2,77	0,89	3,60	1,00	1,06			1,65	0,09
T13. foundry & metal working	1,17	8.24	3,27	4,38	5,37	6,68	0,20	0,53	2,45	3,87	0,04
T14. mechanical equipment	3,46	16,15	2,34	3,05	0,88	2,16	0,04	1,16	0,88	0,22	0,19
T15. electrical equipment	0,07	2,83	20,00	3,94	20,80	1,58				0,12	
T16. land transport equipment		0,59	0,10		0,43	26,66					
T17. Ship building & Aircraft				28,31							
T10. Glass	0,14	0,20	0,41	0,01	0,72	0,63	0,52			0,37	
T11. Chemicals	17,52	0,41	1,17	0,02	3,06	0,76	27,75	8,78	5,18	1,32	0,04
T18. Textile & clothes	3,49	0,07	0,23	0,01	0,37	0,76	0,17	23,34	0,97	3,30	0,08
T19. Leather & shoes	0,09	0,01	0,01		0,19	0,07			9,60	0,05	
T20. Furniture	0,28			0,14	0,23	0,02			0,43	8,33	0,03
T21. paper & paper board	0,90		0,08			004	0,03	0,84	0,10	0,77	15,90
T23. rubber, plastic	1,97	1,15	0,59	0,09	3,32	4,21	0,90	0,23	5,39	4,03	0,20
T09. construction materials	0,19	0,17	0,07		0,03	0,07	0,06	0,01	0,01	0,01	
packing	1,19	0,44	0,42	0,03	1,65	0,24	6,22	1,19	1,35	1,52	0,26
unidentified	3,00	0,18	0,21	0,51	0,23	0,59	0,14	3,22	0,14	0,10	0,41
sub constructing	0,87	5,35	1,58	4,02	1,68	1,05	1,76	6,41	4,71	1,77	5,81
sub processing	5,57	7,78	9,13	9,33	7,75	4,82	10,49	5,81	5,62	7,20	13,10
transportation	3,80	3,34	2,90	1,42	2,82	3,01	3,81	2,59	3,35	4,84	6,10
working expenses	1,75	1,91	1,99	1,04	4,02	1,46	5,17	2,60	2,94	2,69	6,18
value added	**37,06**	**46,82**	**35,08**	**45,97**	**35,77**	**35,15**	**36,92**	**40,24**	**45,28**	**37,87**	**49,64**
net wages	22,66	26,14	21,37	27,10	19,05	21,98	21,71	27,17	26,69	25,02	35,45
employers contributions	7,48	10,08	7,37	10,11	6,67	8,08	7,08	9,34	9,03	8,95	10,85
licence, wage taxes	0,51	0,93	1,03	1,11	0,58	0,86	0,82	1,06	0,97	0,78	0,48
turnover taxes		0,01		0,04	0,31	0,10		0,22			
others taxes	0,29	0,58	0,84	0,44	0,47	0,36	0,65	0,49	0,60	0,44	1,39
gross entrepreneurial income	6,12	9,08	4,47	7,17	8,69	3,77	6,66	1,96	7,99	2,68	1,47
Total	**100,00**	**100,00**	**100,00**	**100,00**	**100,00**	**100,00**	**100,00**	**100,00**	**100,00**	**100,00**	**100,00**
Salaries	8,3	5,9	6,8	4,9	7,4	6,3	5,4	10,1	11,5	9,0	9,6
Capital	68,8	32,7	48,9	43,0	38,8	47,3	42,5	44,1	43,1	41,2	42,2

* the unit of labour coefficients is the number of salaries per million of francs of products. The capital coefficient represents the amount of corporal asset per franc of products (in %)

TABLE 2 : Matrix of industry product-mixes. (C matrix)

Products \ Industries	T 04 Mineral Solid Fuels	T 05 Petroleum & natural gas	T 06 Electricity, gas water	T 07 Iron and Steel	T 08 non ferrous metals	T 09 Construction materials	T 10 Glass	T 11 Basic chemicals	T 13 foundry & metal working	T 21 paper & paper board	T 23 Rubber, plastic	T 14 Mechanical equipment	T 15 A Electrical equipment	T 17 Ship building & Aircraft	T 15 B Household Electrical equipment	T 16 Land Transport equipment	T 12 Parachemicals & pharmaceutics	T 18 Textile & clothes	T 19 Leather and shoes	T 20 Furniture	T 22 Printing & publishing
T04. Solid Mineral fuels	100,00			0,23																	
T05. Petroleum products		99,23						0,12													
T06. Electricity, gas, water		0,08	100,00	0,28				0,15										0,08			
T07. Iron & Steel				87,82					8,65		1,62	0,40				0,01		0,32		0,09	
T08. non ferrous metals				1,49	88,53								0,39		1,03						
T09. construction materials				0,29		94,38		0,32	1,10								0,27				
T10 Glass						0,12	96,67														
T11. Chemicals		0,69		0,02	3,34	0,52		96,39		0,26	2,56						2,30	0,09			
T13. foundry & metal working				5,40	0,64	0,66		0,02	74,75		0,48	3,51	0,72	0,99	3,14	1,11				0,57	
T21. paper & paper board								0,03		96,53	1,17		0,47					1,32	0,19	2,17	
T23. rubber, plastic					1,06	1,65		0,02	1,25	2,08	84,85		0,11		0,35	0,89	1,01	1,48	2,14		
T14. mechanical equipment				3,56		0,86	2,48	0,00	7,38	0,04	2,08	94,38	7,27	4,74	4,78	2,67	0,37	0,43	0,48		
T15. A. Electrics & electronics				0,23	4,92		0,85	0,36	0,45		0,79	0,45	88,89	1,20	7,08	0,09	0,08	0,11		0,40	
T17. Ship building & Aircraft				0,02		0,09			0,21			0,28	0,29	91,76		0,28		0,17			
T15. B. Household elect. equipment									0,61				0,30		82,04						
T16. land transport equipment				0,67					5,17		2,83	0,98	1,47	1,19	1,58	94,82					
T12. Parachemical					1,52			2,42	0,17		0,36		0,07				94,17			0,04	
T18. Textile & clothes						0,93		0,09		0,86	1,78							95,43	2,49		
T19. Leather & shoes											0,73								93,73		
T20. furniture				0,01		0,78		0,08	0,06	0,01	0,46			0,12	0,01	0,12	1,79	0,55	0,95	96,74	
T22. printing, publishing									0,20	0,22	0,30								0,02		100,00
Total	100,00	100,00	100,00	100,00	100,00	100,00	100,00	100,00	100,00	100,00	100,00	100,00	100,00	100,00	100,00	100,00	100,00	100,00	100,00	100,00	100,00

TABLE 3 : Matrix of industry market shares (D matrix).

Products \ Industries	T 04 Mineral Solid Fuels	T 05 Petroleum & natural gas	T 06 Electricity, gas water	T 07 Iron and Steel	T 08 non ferrous metals	T 09 Construction materials	T 10 Glass	T 11 Basic chemicals	T 13 foundry & metal working	T 21 paper & paper board	T 23 Rubber, plastic	T 14 Mechanical equipment	T 15 A Electrical equipment	T 17 Ship building & Aircraft	T 15 B Household Electrical equipment	T 16 Land Transport equipment	T 12 Parachemicals & pharmaceutics	T 18 Textile & clothes	T 19 Leather and shoes	T 20 Furniture	T 22 Printing & publishing
T04. Solid Mineral fuels	87,13																				
T05. Petroleum products		99,96	0,18					1,94													
T06. Electricity, gas, water			99,35																		
T07. Iron & Steel	12,87		0,32	96,82	6,58	1,43		0,03	18,82			5,26	0,28	0,04		0,50				0,05	
T08. non ferrous metals					90,96			1,10	0,52		0,78		1,38				1,48				
T09. construction materials						95.87	0,21	0,15	0,47		1,07	0,26		0,03				0,71		1,55	
T10 Glass							99,77					0,47	0,13								
T11. Chemicals		0,04	0,12			1,09		94,75	0,04	0,13	0,05		0,30				7,09	0,23		0,57	
T13. foundry & metal working				2,25		1,29			61,62		0,94	2,58	0,13	0,09	0,83	0,92	0,17			0,14	0,78
T21. paper & paper board								0,05		91,11	0,97	0,01						0,47		0,02	0,54
T23. rubber, plastic				0,59				1,20	0,55	2,48	89,41	1,02	0,32			0,71	0,50	2,20	4,04	1,50	1,58
T14. mechanical equipment				0,22					6,13			69,83	0,27	0,26		0,37					
T15. A. Electrics & electronics					1,52		0,02		2,21	2,63	0,31	9,42	94.33	0,48	1,54	0,97	0,27				0,05
T17. Ship building & Aircraft									1,99			4,06	0,84	98,33		0,52				0,66	
T15. B. Household elect. equipment					0,94				2,25		0,23	1,46	1,76		97,62	0,24				0,02	
T16. land transport equipment				0,01					5,20		3,80	5,29	0,15	0,69		95,76				1,63	
T12. Parachemical						0,31		0,74			0,74	0,13	0,02				90,47			3,99	
T18. Textile & clothes			0,03	0,09				0,03		2,28	1,26	0,17	0,04	0,09				95,81		1,45	
T19. Leather & shoes										0,07	0,42	0,04						0,57	95,96	0,57	0,02
T20. furniture				0,01					0,18	1,30			0,04				0,01			87,85	
T22 printing, publishing																					97,03
Total	100,00	100,00	100,00	100,00	100,00	100,00	100,00	100,00	100,00	100,00	100,00	100,00	100,00	100,00	100,00	100,00	100,00	100,00	100,00	100,00	100,00

TABLE 4 : Commodity x commodity matrix ("hybrid" technology).

Branches / Products	T 04 Mineral Solid Fuels	T 05 Petroleum & natural gas	T 06 Electricity, gas water	T 07 Iron and Steel	T 08 non ferrous metals	T 09 Construction materials	T 10 Glass	T 11 Basic chemicals	T 13 foundry & metal working	T 21 paper & paper board	T 23 Rubber, plastic	T 14 Mechanical equipment	T 15 A Electrical equipment	T 17 Ship building & Aircraft	T 15 B Household Electrical equipment	T 16 Land Transport equipment	T 12 Parachemicals & pharmaceutics	T 18 Textile & clothes	T 19 Leather and shoes	T 20 Furniture	T 22 Printing & publishing
T01. Agriculture					— 0,01	— 0,01		0,13	—0,01	9,11	0,02	0,01	— 0,05	— 0,01		— 0,01	0,41	0,23	0,13	9,72	
T02. 03. Food & Agricultural industries		— 0,01			— 0,06	— 0,01		1,22		0,25	0,03						1,02		5,51	0,61	
T04. Solid Mineral fuels	76,16	0,03	2,98	10,35	2,13	1,04	0,01	0,69	0,26	0,07	0,02	0,04	0,02	0,01	0,03	0,12	0,03	0,15	0,02		0,01
T06. Electricity, gas, water		0,22	0,60	3,75	7,53	5,14	3,94	3,92	1,77	2,08	1,85	0,87	0,77	0,54	0,68	0,88	0,92	1,35	0,83	1,47	0,81
T12. Parachemical			0,12	0,41	0,22	0,67	0,10	0,19	0,94	0,45	0,32	0,36	0,24	0,29	1,64	0,64	1,74	0,45	0,75	5,05	1,09
T05. Petroleum products		64,07	15,86	1,68	1,46	8,[illegible]8	3,64	12,77	0,45	3,05	1,22	0,49	0,19	0,33	0,02	0,45	0,51	0,69	0,51	0,57	0,04
T07. Iron & steel			0,30	23,85	0,17	1,[illegible]6	0,85	0,01	15,17	0,01	3,74	9,38	2,14	4,59	4,25	6,78	0,06		— 0,05	1,57	
T08. non ferrous metals			1,29	4,37	43,05	0,[illegible]3	0,55	0,77	3,91	0,30	0,49	1,18	3,10	0,89	3,39	1,00	1,06	— 0,01	— 0,01	1,59	0,09
T13. foundry & metal working		0,02	0,67	2,57	0,60	0,13	1,21	0,42	3,87	0,81	1,18	7,52	3,26	4,37	5,49	6,62	0,17	0,52	2,47	3,70	0,04
T14. mechanical equipment		0,28	0,94	3,25	1,05	2,69	1,33	2,03	1,86	1,27	3,52	13,95	2,36	3,04	— 0,18	1,78	— 0,03	1,16	0,79	0,25	0,19
T15. electrical equipment		0,02	1,50	0,67	0,67	0,33		— 0,08	0,63		0,06	4,33	19,73	4,02	23,41	1,73	— 0,03	— 0,03	— 0,01	0,04	
T16. land transport equipment				0,03	— 0,01				1,04			0,29	0,10		— 0,08	27,22				— 0,01	
T17. Ship building & Aircraft						— 0,03			0,62			1,09	0,24	28,19		0,07					
T10. Glass				— 0,01	— 0,01	— 0,01	1,63	0,01	0,02		0,15	0,21	0,41	0,01	0,82	0,64	0,52			0,37	
T11. Chemicals		0,36	0,06	0,49	2,01	1,30	3,43	23,62	0,41	5,44	17,80	0,67	1,18	0,03	3,48	0,74	27,96	8,83	5,11	2,66	0,04
T18. Textile & clothes			0,05	0,17	— 0,04	0,08	0,01	— 0,03	0,05	0,87	3,48	0,15	0,23	0,03	0,40	0,77	0,17	23,73	4,51	3,57	0,08
T19. Leather & shoes			0,02	0,01		0,02			0,01		0,05	0,01	0,01		0,12	0,07			9,93	0,10	
T20. Furniture			0,05	0,17		— 0,02	0,12		0,01	0,06	0,29	0,01		0,13	0,28	0,01			0,44	7,97	0,03
T21. paper & paper board			0,07	0,01	0,03	0,23		— 0,01	0,02	26,94	0,90	0,02	— 0,07			0,04	0,03	0,48	0,03	0,19	15,90
T22 other, plastic			0,05	— 0,02	0,75	0,38	0,15	— 0,01	0,32	0,31	2,06	1,02	0,58	0,09	3,82	4,27	0,90	0,23	5,56	3,94	0,20
T09. construction materials		— 0,05	0,12	1,85	0,63	9,20	6,16	7,22	0,42	0,18	— 0,04	0,19	0,09		— 0,01	0,06	0,04		0,01	0,05	
packing		0,22		0,24	0,34	2,92	6,74	1,09	0,70	0,94	1,22	0,47	0,42	0,03	1,91	0,23	6,25	1,19	1,36	1,71	0,26
unidentified		0,02	4,47	2,83	2,19	— 0,06	0,45	0,50	1,54	1,42	3,08	0,25	0,23	0,51	0,14	0,59	0,14	3,25	0,05	0,15	0,41
sub constructing	11 73	1,49	4,24	3,32	2,52	1,31	3,02	3,33	5,52	0,28	0,70	4,95	1,62	4,01	1,33	0,93	1,75	6,51	4,67	1,85	5,81
sub processing		3,73	9,90	7,00	5,94	7,87	8,44	10,07	7,63	4,91	5,41	7,96	9,12	9,33	7,72	4,78	10,51	5,81	5,61	7,32	13,10
transportation	5,40	5,15	1,84	5,16	5.84	8.83	8,39	6,34	4,62	4,68	3,71	3,29	2,91	1,42	2,67	2,99	3,80	2,56	3,37	4,75	6,10
working expenses	0,14	0,67	1,35	1,03	1,18	1,63	2,10	1,46	1,98	1,53	1,76	1,89	1,96	1,04	4,50	1,45	5,19	2,62	2,95	2,80	6,18
value added	**6,56**	**23,78**	**53,52**	**26,84**	**21,84**	**46,02**	**47,72**	**24,36**	**46,25**	**35,04**	**46,96**	**39,39**	**49,21**	**37,14**	**34,15**	**35,14**	**36,87**	**40,30**	**45,47**	**38,01**	**49,64**
net wages	0,02	2,61	15,53	19,56	17,74	22.13	34,24	18,59	25,93	21,31	27,44	22,58	26,94	22,69	17,84	22,00	21,70	27,27	26,71	25,03	35,45
employers contributions		0,98	8,75	7,30	6,76	7,78	11,74	6,93	9,91	7,35	10,25	7,73	8,61	7,49	6,28	8,08	7,07	9,37	9,04	8,93	10,85
licence, wage taxes	0,18	0,16	2,87	0,95	0,74	1,08	1,01	0,98	0,91	1,03	1,11	0,85	0,57	0,51	0,54	0,86	0,82	1,06	0,97	0,79	0,48
turnover taxes			0,04			0,46	0,01				0,04	0,06	0,04		0,37	0,10		0.22	— 0,01		
others taxes	0,10	14,99	1,90	0,43	0,65	0,52	0,39	0,56	0,57	0,84	0,43	0,47	0,50	0,29	0,46	0,36	0,5	0,48	0,60	0,44	1,39
gross entrepreneurial income	6,26	5,04	24,43	— 1,40	— 4,05	14,05	0,33	— 2,70	8,93	4,51	7,69	7,70	12,55	6,16	8,66	3,74	6,63	1,90	8,16	2,82	1,47
Total	**100,00**	**100,00**	**100,00**	**100,00**	**100,00**	**100,00**	**100,00**	**100,00**	**100,00**	**100,00**	**100,00**	**100,00**	**100,00**	**100,00**	**100,00**	**100,00**	**100,00**	**100,00**	**100,00**	**100,00**	**100,00**
Salaries	0,7	0,5	3,8	5,3	4,0	5,5	8,7	4,0	6,6	5,1	8,4	6,0	6,8	4,9	7,6	6,3	5,3	10,1	11,6	9,0	9,6
Capital	77,0	31,9	294,4	103,3	80,1	111,5	74,9	89,9	42,7	66,1	67,7	35,1	49,2	43,0	37,3	47,7	42,3	43,6	43,0	41,1	42,2

* the unit of labour coefficients is the number of salaries per million of francs of products. The capital coefficient represents the amount of corporal asset per franc of products (in %)

2 - THE ECONOMETRIC METHOD

The idea underlying this method is to go directly from firms microeconomic data over to branch macroeconomic coefficients. When all firms are "pure", that is to say when each of them produces a single commodity, this is not difficult to do since their mere aggregation by commodity gives the different branches. Generally, firms are diversified and accounting records only furnish inputs and outputs relating to them, without detailing how each input is allocated to each output.

How to use the information provided by each firm accounting records in order to perform this allocation at the macroeconomic level ? How can inputs be allocated to the proper outputs ?

It has long been considered (see KLEIN [1956]) to refer to a probabilistic model. When allocating an input to its different productive uses, each firm in the economy or in a representative sample fits statistically to an average technical structure, according to Leontief's assumption of a fixed technical coefficient for each branch. The stochastic framework for computing an input-output table actually offers several advantages. It gives a measure of the dispersion of the coefficients. It considers the fact that firms at best conform inperfectly to technological hypothesis. And it also recognizes the stochastic nature of sample data based on accounting records.

Along these lines, OSAKI [1971] proposed the linear model as a method for computing the coefficients of primary factors by branch. Simultaneously, CHAUMONT and ARKHIPOFF [1975] applied this method to the confection of national accounts in the Cameroons where it is still used (see OSBERT and MEUNIER [1979]).Since then, current research has followed different directions, on a rather independent basis. GERKING [1976] proposed different methods of estimation which take into account errors in the measurement of explanatory variables as well as a better specification of the distribution of residuals. His models however remain within the framework of non-diversified production (pure firms).

Another line of research consisted in extending this model to allow for accounting constraints on data and for a priori information on coefficients. On this matter, see GERKING [1979] and particularly MENSINK [1974]

This research was partly orientated even though insufficiently, on the sampling techniques which permit, without loosing too many data, to bring back within acceptable limits the cost of estimating such models (cf. CHAUMONT and ARKHIPOFF [1971] and ISARD and LANGFORD [1971]).

The proposed model lies within the general framework of multi-product firms. Special attention is given to the distribution of disturbances, heteroskedasticity, accounting constraints and errors in variables. We also examine current problems in implementing the method (integration of a priori information, treatment of negative coefficients, etc...). The results will be presented in the end.

2.1. The model

a - As for the algebraic method, two polar assumptions will be confronted as concerns technology.

(i) Firm technology : A commodity has no specific technology but the technology of the firm producing it.

(ii) Commodity technology : Technology is linked to the commodity in a specific way, no matter what the producing firm is.

These two assumptions are similar to the ones used in the algebraic method, when the rationale bears on firms and not on industries. The firm technology assumption will be introduced here in an accessory way to solve certain problems raised by the application of the method. From now on, the productive system only admits of a commodity - technology.

Let us add the following assumption : for each product, the production functions of the firms are of the zero substitution between factors and constant returns to scale type.

In the commodity technology the firm which produces a particular commodity has to comply with a certain structure of costs depending on the commodity and not on the firm. Its specific feature is a certain random term which makes it deviate from this fixed structure of costs. When the firm produces several commodities, its global structure of inputs will be a compound of the inputs required for the production of each of these commodities, always allowing for a small random divergence.

For a firm k, the technological assumption implies for the amount of input i used :

$$(1) \quad x_i^k = a_{i1}\ y_1^k + \ldots\ldots + a_{iJ}\ y_J^k + u_i^k$$

in which :

x_i^k is the value of input "i" used by firm "k" ;

y_j^k is the value of commodity "j" produced by firm "k" ;

a_{ij} is the value of input "i" included in one unit of commodity "j",

u_i^k is a random residual linked to the use of input "i" by firm "k".

An input i (resp. factor g) will consequently give K equations of the type (K number of firms in the sample) which permit writing the basic relations for all inputs and factors :

$$(2) \quad x_i = Ya_i + u_i \qquad i = 1, \ldots, I$$

$$(3) \quad x_g = Yb_g + v_g \qquad g = 1, \ldots, G$$

With obvious vector notations and where $Y = [y_i^k]$ is the matrix (K, J) of the productions of the K firms for the J commodities.

If the model is written jointly for all inputs, grouping equations (2) gives :

$$(4) \quad \begin{bmatrix} x_i \\ x_2 \\ \vdots \\ x_I \end{bmatrix}_{(KI,1)} = \begin{bmatrix} Y & O & \ldots & O \\ O & Y & & \\ \vdots & & & \\ O & & & Y \end{bmatrix}_{(KI,IJ)} \begin{bmatrix} a_1 \\ a_2 \\ \vdots \\ a_I \end{bmatrix}_{(IJ,1)} + \begin{bmatrix} u_1 \\ u_2 \\ \vdots \\ u_I \end{bmatrix}_{(KI,1)}$$

or, in a more condensed way :

$$(5) \quad \mathcal{X} = \mathcal{Y} a + u$$

where $\mathcal{Y} = I_I \otimes Y$ using Kronecker product between the dimension I unit matrix and matrix of firm productions Y.

We obtain similarly for production factors, through a superposition of the G models (3) :

$$(6)\quad \mathcal{G} = \mathcal{Y}\, b + u$$

When the number K of firm excedes the number J of outputs, the least squares method can be applied to models (5) and (6). The estimates obtained for a and b are unbiased if

$$(7)\quad E(u) = 0 \quad \text{and} \quad E(w) = 0$$

similarly, if we have for the second order moments of the disturbances

$$(8)\quad E(uu') = V \text{ and } E(ww') = W \qquad \text{positive definite matrices}$$

then the estimators of technical coefficients and factors are of minimum variance and given by :

$$(9)\quad \begin{aligned} \hat{a} &= (\mathcal{Y}'\, V^{-1}\mathcal{Y})^{-1}\, \mathcal{Y}'\, V^{-1}\, \mathcal{X} \\ \hat{b} &= (\mathcal{Y}'\, W^{-1}\mathcal{Y})^{-1}\, \mathcal{Y}'\, W^{-1}\, \mathcal{G} \end{aligned}$$

with variances respectively equal to $(\mathcal{Y}'\, V^{-1}\mathcal{Y})^{-1}$ and $(\mathcal{Y}\, W^{-1}\mathcal{Y})^{-1}$

Let us note that the coefficients of equations (2) are <u>the rows of the I-O table</u> and <u>not columns</u> as one could expect. The explained variables here are inputs and not outputs. The point is not to estimate functions of production, either on an assumption of complementarity (of the Leontief type) or admitting of a certain substitution. Precisely, equations (2) give the quantities of inputs required by firms if they all conform to Leontief's functions of production, with complementary inputs and constant returns to scale.

Here appears the twofold character of the linear model as it is set in equations (2) and (3).

From the economist's point of view, its purpose is to test this assumption on the firm's economic behaviour : a demand for production factors, or for intermediate inputs, which is proportionate to the produced value, whatever is the price system ; so to say, an assumption on the firms' behaviour which is extremely elementary. To be valid, it implies that all firms verify Leontief technology for each of its products. Weakening this assumption by admitting substitution between factors amounts to adopting the assumptions of the non-substitution theorem (constant return to scales, a single rare primary factor and no joint production). However, we can scarcely go further and propose the model as a formalization of the firm's demand in intermediary commodities.

It is also possible to adopt the philosophy of national accountants when they construct the I-O table. For them, there are very few economic assumptions, but merely the objective of summing up all production flows without prejudice of the variety of individual behaviours they cover. In other words, a framework which is descriptive and not explanatory. The problem reduces to this : on the basis of a certain system of prices and demand for goods and factors, each firm verifies a relation between inputs and outputs which is given by the a_{ij}^{k} and depends on the firms. How is the macroeconomic a_{ij} to be determined when transactors and commodities are aggregated simultaneously ?

In this empirical view, the only problem which has to be solved is the aggregation one. And the linear model only intervenes as a statistically controlled way of determining this "aggregated" technology.

Naturally, the conclusions are not the same in both approaches. If the first one can be used for the verification of assumptions on the productive system (complementarity or substitutability of inputs, constant productivity of factors according to size), it is on the second approach that the present work rests.

b - The accounting constraint and the model

Here we focus our attention on the model of branch technical coefficients - Equation (5). Let the covariance linking the use of inputs i and i' by firms k and k' be :

$$\sigma_{ii'}^{kk'} = E\, u_i^k \; u_{i'}^{k'}.$$

Let us note that the I grouped models are not independant : the disturbances peculiar to a firm are linearly dependant due to the accounting constraint on firms' operating account. Formally, $Euu' = V$ is no longer invertible and the vector *a* of the technical coefficients is no longer obtained through formula (9).

Each firm in the population is such as :

(10) $\sum_{j=1}^{J} y_j^k = \sum_{i=1}^{I} x_i^k$ when value-added elements are incorporated into the model.

Then if we add the I equations relating to one firm, we have :

$$\sum_{i=1}^{I} x_i^k = \sum_{i=1}^{I} \sum_{j=1}^{J} a_{ij} \; y_j^k + \sum_{i=1}^{J} u_i^k$$

and thus : $\sum_{i=1}^{I} u_i^k = \sum_{j=1}^{J} (1 - \sum_{i=1}^{I} a_{ij}) \; y_j^k$ knowing (10).

The right hand side of this equality is non random so that $\sum_i u_i^k$ is equal to its expectation which is zero, $\forall \; k = 1, \ldots, K$.

From that we first derive :

(11) $\sum_{j=1}^{J} (1 - \sum_{i=1}^{I} a_{ij}) \; y_j^k = 0 \qquad k = 1, \ldots, K$

The relation being true for all firms with $y_j^k \geqslant 0$, we obtain :

$$\sum_{i=1}^{I} a_{ij} = 1 \qquad \forall_j = 1, \ldots, J.$$

This result removes the risk of an anarchical - and therefore uneven - dispersion of coefficients on one branch as compared to another when breaking down firms into their productive components. When going from firms

over to branches, the operating accounts remain balanced (1)(2).

On the other hand, premultiplying $\sum_i u_i^k = 0$ by $u_{i'}^{k'}$ and taking expectations, we obtain :

$$(12) \quad \sigma_{1i'}^{kk'} + \sigma_{2i'}^{kk'} + \ldots + \sigma_{Ii'}^{kk'} = 0 \qquad \forall k', \ \forall i'$$

These K.I relations (12) define a set of K linear constraints between the vectors in matrix V, which is then of rank K(I - 1) and not invertible.

Theil mentions ([1971] § 6.7) this problem of the estimate of models by means of a singular covariance matrix. The solution is based on a generalization of Gauss-Markoff theorem which yields as an estimator for *a*, unbiased and with minimal variance :

$$(13) \quad \hat{a} = (\mathcal{Y}' V^+ \mathcal{Y})^{-1} \mathcal{Y}' V^+ \mathcal{X}$$ where V^+ is the generalized inverse of V.

and $V(\hat{a}) = (y' V^+ y)^{-1}$

In this particular problem, it may be noted that, being aware of constraint (10) and the I - 1 equations relating to the I - 1 inputs, the last equation is obtained through

$$x_I^k = \sum_{j=1}^{J} y_j^k (1 - \sum_{i=1}^{I-1} a_{ij}) + \sum_{i=1}^{I-1} u_i^k$$

(1) This results only holds when there is no other constraint on the coefficients other than the accounting constraint. Thus, in a more general model with constraints on the coefficients, we must reintroduce the equilibrium constraint into the operating accounts of the branches.

(2) The balance of operating accounts by branch does not imply that the inputs estimated by the model on all the firms are equal to the actual amounts of inputs observed. If we want to allow for such a constraint, mentioned by Brown and Garratiana [1979], it becomes necessary to restore the balance of the coefficient table by use of RAS-type procedures.

The data relating to this last input - let us call it the entrepreneurial income - give no information to estimate the technical coefficients. It can be shown that it suffices to apply the generalized least squares (g. l.s) on the first I - 1 equations and obtain the technical coefficients of the last input through :

$$(14) \quad \hat{a}_{Ij} = 1 - \sum_{i=1}^{I-1} \hat{a}_{ij}$$

In the following, the symbols adopted relate to the first I - 1 inputs.

c- Assumptions on the covariances of disturbances

To conduct the estimation of model (5) in a practical way, some restrictive assumptions are to be made on the second order moments.

A first assumption seems reasonable : there are no "external effects" between the production processes of different firms :

$$(15) \quad \sigma_{ii'}^{kk'} = 0 \quad \text{if } k \neq k' \text{ and } \forall i, i' = 1, \ldots, I - 1$$

But such a restriction is not sufficient to allow an estimation of the technical coefficients. We must therefore introduce assumptions on the nature of the "internal effects" specific to the production process of individual firms.

In particular, the set of variances/covariances is not independent of firms. Some heteroskedasticity is introduced as much on account of the size of the firms as of their sectoral or geographical origin.

The following assumption will be made for this heteroskedasticity :

$$(16) \qquad \sigma_{ii'}^{k} = \sigma_{ii'} \, \lambda_k$$

The covariance associated with the entry of two inputs i and i' in the production process of firms is proportional to a variable λ_k proper to each firm ("size effect"). With (15) and (16), the model may thus be given its general form :

$$(17) \quad \mathcal{X} = \mathcal{Y}a + u$$

with $E(u) = 0$

$Vu = \Sigma \otimes \Lambda$

in which :

$\Sigma = [\sigma_{ii'}]$ having the format $(I - 1, I - 1)$

Λ = diagonal matrix (K,K) whose k - th diagonal term is λ_k ;

We recognize in model (17) a case where the g.l.s. on the grouped model are identical to the g. l. s. on each regression. Practically, model (17) consists in applying the o. l. s. independently to the I - 1 equations after reducing the inputs and outputs of each firms by the factor $1/\sqrt{\lambda_k}$.

The estimators of the technical coefficients are :

(18) $\hat{a}_i = (Y' \Lambda^{-1} Y)^{-1} Y' \Lambda^{-1} x_i$ for a given input i and juxtaposing (and transposing) each of the equations (17), instead of grouping them :

(19) $\hat{A} = X' \Lambda^{-1} Y (Y' \Lambda^{-1} Y)^{-1}$ a formula[1] in which the usual I-O - coefficients can be recognized and which, in columns, gives the costs structure of a branch (including the operating accounts by branch).

The variance of $\hat{a}$ is given by :

$$V(\hat{a}) = \Sigma \otimes (Y' \Lambda^{-1} Y)^{-1}$$

---

(1) In this formula, the technical coefficients relating to the last input are obtained according to (14) and added as the ultimate row in the input-output table.

and the estimations of the covariances in matrix $\sum$ are calculated through :

$$\hat{\sigma}_{ii'} = \frac{1}{K-J} \sum_{k=1}^{I} \frac{\hat{u}_i^k \; \hat{u}_{i'}^k}{\lambda_k}$$

The major characteristic of the model is that the first order properties of the estimators do not depend on the nature of the interdependences between the users of inputs, i.e. matrix $\sum$.

But we must acknowledge the importance that the analysis of such variance matrix would have for the study of the productive system and the production functions of branches. A positive $\sigma_{ii'}$ (resp. negative) is an indication of complementarity (resp. substitutability) in the use of the inputs or factors i and i' on the whole population of firms. This way, however, was not followed here. To estimate the statistics associated with coefficients, we assumed that $\sum = \sigma^2 I$.

d - Which heteroscedasticity correction ?

Various corrections of heteroskedasticity have been successively tested for model (17).

(a) Homoskedasticity. Firms are not corrected for any size effect $\Lambda = I$.

(b) the variable λ proportional to the variance is made of the firms' turnovers :

$$\lambda_k = \sum_{j=1}^{J} y_j^k$$

(c) the variable λ is equal to the square of the firms' turnovers :

$$\lambda_k = \left(\sum_{j=1}^{J} y_j^k \right)^2$$

Each input and each output is then reduced by : $\sqrt{\lambda_k}$. Thus we reason on firms' ratios and not on amounts.

The best results - as far as the accuracy of the estimations is concerned - are obtained with (b). It is possible to explain this by supposing that one industry of the economy is only made of "pure" firms producing nothing but the specific commodity of that industry, whose commodity is furthermore not produced by any firm in any other industry.

For a given input, the natural input coefficient for the branch is :

(20) $a = \sum x / \sum y$, that is to say the average technology (the ratio of the total input to the total output) in which firms intervene in proportion to their production :

$$a = [\sum (x/y)\ y] / \sum y$$

Now, applying the least squares to our example, the results are as follows, depending on the various assumptions made for heteroscedasticity :

Correction (a) : $\hat{a} = \sum xy / \sum y^2$
Correction (c) : $\hat{a} = \frac{1}{K} \sum x/y$
Correction (b) : $\hat{a} = \sum \frac{x}{\sqrt{y}} \cdot \frac{y}{\sqrt{y}} / \sum (\frac{y}{\sqrt{y}})^2 = \sum x / \sum y$

Through (a), each input coefficient of a firm is weighted by the square of the firm's production : $\hat{a} = \sum a^k y^2 / \sum y^2$, and large-sized firms have a prevailing importance. In the case of (c), the estimation is valid only when the firms have the same importance. Then, we have : $\frac{1}{K} \sum x/y = \sum x / \sum y$. Otherwise, this way of removing the size effect lends too heavy a weight to small firms and introduces a heteroscedasticity of opposite direction.

Thus an intermediary reduction - correction (b) - is necessary, at least in this trivial case where the aggregate of firms stands for the branch.

It is then adopted for cases with several outputs[1].

2.2. Problems and limitations

a - Increase in stocks and errors on explanatory variables.

Errors made by firms when they answer questions concerning their sales, the non inclusion of intregated productions into such sales and lastly the way adopted for dealing with the increase in stocks or work in process, may bring in errors on the explanatory variables.

It is a case where applying g. l. s. to model (17) gives biased and non consistent estimators for the technical coefficients.

GERKING [1976, 1979] suggests removing this bias by choosing the double least square estimator rather than the g. l. s. of equation (18). The variables he proposes to bring back the firms' production vectors into a space where they are not correlated with the disturbances, are the value-added elements (exclusive of gross operating surplus) of the firm (e. g. wages and taxes). Such data are not subject to inventory variations and, furthermore, the quality of their evaluation is warranted by their appearance in the firms' tax records which makes a comparison possible.

The point is then to regress each of the outputs on these operating elements and to introduce the estimated outputs thus obtained into equation (17) which determines the technical coefficients.

This process was not applied here. As a matter of fact :

- the new estimated outputs do not verify the constraints on the operating accounts of firms. The column sum of the branch technical coefficients is no longer equal to 1 ;

(1) MENSINK [1974] holds to the homoskedasticity assumption for the whole sample through an appropriate stratification of his population of firms.
He thus conducts separate estimations by major industry and by amount of turnover. But this stratification not only reduces the macroeconomic advantage of the method (the aggregation of partial estimates obtained remains in fact to be made) ; it also needs sufficient accuracy to remove all heteroskedasticity. Very soon we come up against the constraint of an insufficient number of firms in the sample.

- above all the instrumental variables retained are only slightly correlated with each of the outputs taken individually. The gain on the bias of estimators is obtained at a price : a heavy loss of information on the firm's technical data.

b - A priori constraints on the coefficients

Another deficiency of the method lies in its blindness when the statistician may have good reasons to think (through mere common sense or use of other statistical sources) that a technical coefficient should have a determined value.

The general framework which makes it possible to integrate such a priori information is the regression with linear constraints on the coefficients. Equality constraints for predetermined coefficients, inequality constraints for non-negative coefficients.

But solving becomes difficult and it may be profitable to look for a simpler integration of a priori information.

Let us assume the case of a coefficient we know to be zero but which is nevertheless given as positive when applying the model. This appears in two cases :

. When there are vertically integrated firms : such is the case for foundry very often integrated into mechanical or automobile construction. The foundry inputs then show up necessarily in the mecanical products made from foundry products.

. When firms are too diversified. If too many firms produce both milk products and flat glass, the coefficients obtained by adjusting the models for the milk and for the glass inputs will be sort of quadratic means of the amounts appearing as inputs and outputs. It then seems unavoidable that a fraction of the milk will be allotted to the "glass" branch and that, at least econometrically, various minerals will be found in the yoghurts produced.

To conduct the estimation one then uses the result according to which it is equivalent either to apply the g. l. s. with constraints $a_{ij} = 0$ on one or several coefficients, or to apply the g. l. s. on the models from which are removed the variables associated with the coefficients desired to be equal to zero.

For a coefficient $a_{ij} = \overline{a}_{ij} > 0$, the result is the same : a constraint is introduced in the model by fixing the coefficient and estimating the equations associated with the firm k :

$$(21) \qquad x_i^k - \overline{a}_{ij} \quad y_j^k = \sum_{l \neq j} a_{il} \quad y_l^k + u_i^k \qquad k = 1, \ldots, K$$

The problems raised by this procedure are the following :

- the cause of the non-zero coefficient, i. e. the joint production or vertical integration, is carried over onto the other coefficients ;
- the equation - by - equation estimation of the model, valid within assumption (15), holds no longer true ; the set of explanatory variables is no longer common to all the equations.
- the accounting constraint is no longer respected and then the column sum of the branch coefficients is no longer equal to 1. Rigorously, the equation of the branches' operating account is to be integrated into the regression model without constraints. Practically, if the coefficient to be constrained is small in the model without constraint, it may be sufficient to distribute the difference with 1 of the branch coefficients over the whole branch.

c - The negative coefficients

As it is the case with the algebraic method, the calculations systematically give negative results for certain entries.

Let us limit their importance at once : when the model is specified at best, certain outputs being dealt with by a firm technology (cf. infra) and the elimination of heteroskedasticity, the results give no significant negative coefficient. The largest of these amounts to - 1,58 % for "Land Transport equipment" in the branch "Rubber and plastic" with a t of Student equal to - 1.1.

Formally, the question may be dealt with as previously, introducing this time inequality constraints on the coefficients ($a_{ij} \geq 0$), and estimating the a_{ij} as the solution of a quadratic programme under linear constraints.

But these automatic methods should be considered with suspicion in that they artificially settle errors in the specification of the model and in the firm sample, as well as data incoherences.

This is why it is necessary to understand the origin of such negative coefficients.

Here are, for instance (table 5) the results of the adjusted model for input n° 4 "Solid Mineral Fuels", (SMF) concerning the four main user branches, one of which is the "Foundry" branch.

TABLE 5

"Coal & cokefaction"
Estimated coefficients of input n° 4
(t of Student between brackets).

	Solid mineral fuels N° 1 (T 04)	Electricity gas N° 3 (T 06)	Ferrous metals N° 4 (T 06)	Working of metals foundry N° 9 (T 13)
Model a without correction of size	82,40 (15.4)	5,34 (39.9)	13.01 (39.5)	- 6.07 (- 3.98)
Model b with correction	76.84 (27.7)	3.05 (8.2)	11.08 (28.7)	- 1.41 (- 1.64)
Model "Hybrid technology"	76.16	3.34	10.84	- 0.93

How can $a_{49} = - 1.41$ % be explained for "coal" in "Foundry", in the model corrected for size effects ?

The following considerations appeal to inter-relations between input x and outputs.

i. Certain outputs have no part to play in the reasoning : these are outputs "orthogonal" to the "foundry" branch, and to the branch with which the latter is correlated, i. e. such as $C_{ij} = 0$ where $C_{ij} = \sum_k y_i^k \; y_j^k$ stands for the uncentered second order moment(1). They do not appear in the determination of the technical coefficients.(2)

An analysis of the matrix of the non-centered moments or a principal components analysis on non-centered variables appearing on table [X, Y] shows that, in our example, the outputs correlated with "Foundry" are "Coal and coke" (N° 1), "Electricity and gas" (N° 2), and at a lesser extent "Ferrous metals".

The other outputs are unsignificantly correlated with "Foundry" and have a rather small impact on the coefficients in our example. These remarks made it possible to reason on a reduced number of variables when examining each negative coefficient. In practice never more than 3 or 4.

ii) Let us suppose that the model has only two outputs, y_1 and y_2.(3) And let $\bar{a}_1 < 0$.

A calculation of the coefficient gives :

$$\hat{a}_1 = \frac{1}{V_1 \; V_2 - 2C_{12}} \left[V_2 \; C_{1x} - C_{12} \; C_{2x}\right] \tag{22}$$

(1) Let us note as well C_{jx} the second order moment linking output j to the input ; $V_j = \Sigma \, (y_j^k)^2$ the squared moment. As the model does not contain any constant term, it is not possible to reason directly in terms of correlation nor partial correlation.

(2) This line of reasoning justifies the application of the method to firms belonging to diversified industries. When industries are disconnected the model is separable or quasi-separable. For industries whose activities are close to one another-in which case the argument no longer holds-it appears that an error would be made when estimating the technology of a branch if only firms of the industry in that branch where taken. The commodity technology would thus be left out when the commodity is used by industries in which it is not the main production. The advantage of the method lies in the aggregation of various activities of firms.

(3) In a one-output model, there can be no negative coefficient.

The determinant being always positive, $\hat{a}_1$ can be negative only if $V_2\, C_{1x} < C_{12}\, C_{2x}$.

If y_2 is the main output, C_{2x} is rather large. It is then sufficient that y_1 be little correlated with the input, but on the contrary rather well correlated with the main output so that the coefficient $\hat{a}_1$ becomes very small.

If furthermore the main output is of little importance in the economy (small V_2), $\hat{a}_1$ can assume negative values.

iii. The case with 3 inputs is analysed in an identical way ; we then have :

$$(23) \quad \hat{a}_1 = \frac{1}{\Delta}\left[C_{1x}\,(V_2V_3 - C_{23}{}^2) + C_{2x}(C_{23}C_{13} - V_3C_{12}) + C_{3x}(C_{12}C_{23} - V_2C_{13})\right]$$

Then, if the input is not natural of output 1 but is on the contrary used a great deal for outputs 2 and 3 (small C_{1x}, large C_{2x} and C_{3x}), if furthermore output 1 is rather closely correlated with one or the other of the remaining two outputs, each other being themselves little correlated, then the only relatively important terms become :

$$C_{1x}\,V_2V_3 - C_{2x}V_3C_{12} - C_{3x}V_2C_{13}$$

As they consume a great part of the input, outputs 2 and 3 draw the coefficients to them and the result may well be negative for $\hat{a}_1$.

iv. The previous remarks can be used to explain the negative coefficient of the input SMF in "Foundry". The initial problem is actually of industry diversification : "Foundry" is a small user of SMF but its activity is generally associated with other ones, mainly "Ferrous metals", which are large consumers of them. The primary cause therefore lies in the existence of associated activities (Coking and Ferrous metals) in which there is a strong component of SMF and which draw coefficients to them (thus the coefficient of the SMF in "Mechanical construction" is also negative - 0.25 %; t = 0.5).

A review of data shows moreover that firms having a joint production of "Foundry" and "Ferrous metals" are not all, as a rule, users of "Coal . The opposite case would have given - between "Coal" and "Foundry" - a second order moment large enough to make the coefficient positive (the term $C_{1x} V_2 V_3$ becoming very large).

The condition requiring C_{jx} to be small is therefore essential. This explains why negative coefficients are only met within models integrating infrequent input ; in practice, besides "Coal", the "Land transport equipment" and the "Aeronautical and aeronaval equipemnt".

The diagnosis is therefore the same in both methods. And it is not by chance that the two major negative coefficients are found for the same entries ; as in the algebraic method a reexamination of data or a different technology assumption make it possible to eliminate such coefficients.(1)

d - Commodity-technology or firm-technology

Certain commodities, with which it is impossible to associate one particular input, are relatively correlated with all the other inputs.

That is the case for "production of a firm for its own use", "margins" and the "non-industrial commodities" item. The preceding diagnosis is confirmed : for these commodities, we find values of technical coefficients which are outliers, often strongly negative.

For these commodities, the commodity-technology assumption underlying the method is inedequate. It would be more convenient for them to make the firm-technology assumption according to which they have the average costs structure of their firm.

In practice, the technological assumption made on these secondary commodities scarcely influences the results concerning coefficients of industrial commodities.

(1) Along these lines, one might then think of restraining our observations in one input model to those firms which use that input in a non zero quantity. But this solution - which has been tested - is wrong : while it does not change Y'X, it generally reduces Y'Y and then raises the order of the variance $(Y'Y)^{-1}$. This result is natural : the firms which produce a given output while not using the input supply a piece of information referring to the exclusivity of the input and the output. They cannot therefore be rejected without prejudicing the estimator's accuracy.

2-3 The results

Table 6 reproduces the complete I - O table in coeffi- cients (including income statements and coefficients of primary factors by branch) estimated with correction b for heteroskedasticity. The associated t's of student are taken up in table 7.

Comments on the results are given in Annex I, where a detailed comparison between the two methods applied to branch T23 - "Rubber and plastic" - is developed.

Table 6

Commodity x Commodity matrix

(econometric model (b) ; input coefficients)

Products \ Industries	T 04 Mineral Solid Fuels	T 05 Petroleum & natural gas	T 06 Electricity, gas water	T 07 Iron and Steel	T 08 non ferrous metals	T 09 Construction materials	T 10 Glass	T 11 Basic chemicals	T 13 foundry & metal working	T 21 paper & paper board	T 23 Rubber, plastic	T 14 Mechanical equipment	T 15 A Electrical equipment	T 17 Ship building & Aircraft	T 15 B Household Electrical equipment	T 16 Land Transport equipment	T 12 Parachemicals & pharmaceutics	T 18 Textile & clothes	T 19 Leather and shoes	T 20 Furniture	T 22 Printing & publishing
T01. Agriculture						0,03		0,15	0,02	9,23	—0,15	0,01	— 0,06				0,11	0,20	— 0,03	10,84	— 0,05
T02. O3. Food & Agricultural industries		— 0,01			— 0,06			0,98		0,22	0,04						1,29		6,24	0,29	
T04. Solid Mineral fuels	76,84	0,02	3,05	11,08	1,73	1,28	0,01	0,73	— 1,41	0,06		— 0,25		0,02	0,11	0,13	0,15	0,14	0,02		
T06. Electricity, gas, water	0,03	0,22	0,59	3,74	8,16	5,24	4,01	3,94	1,94	2,13	1,93	0,86	0,58	0,48	0,73	0,87	0,83	1,29	0,72	1,57	0,86
T12. Parachemical	0,02	0,01	0,12	0,42	0,24	0,68	0,08	0,14	0,96	0,46	0,22	0,38	0,22	0,23	1,52	0,66	1,86	0,42	0,71	5,42	1,39
T05. Petroleum products	0,10	62,82	15,97	1,72	1,63	8,64	3,78	12,89	0,34	3,15	1,07	0,46	0,09	0,31	0,04	0,46	— 0,47	0,64	0,59	0,57	0,03
T07. Iron & steel	— 0,87		0,24	25,17	— 0,25	1,93	0,61	0,05	14,00	— 0,19	3,45	9,41	1,30	3,89	4,65	6,94	— 0,04	— 0,14	— 0,18	1,69	0,12
T08. non ferrous metals	— 0,27	0,01	1,29	3,92	45,09	0,29	0,53	0,63	5,09	0,21	0,44	0,66	3,34	0,83	3,40	0,91	0,83		— 0,04	1,95	0,12
T13. foundry & metal working	0,10	0,03	0,66	2,26	0,56	0,24	0,97	0,45	2,95	0,67	0,91	9,69	2,56	3,61	5,46	6,96	0,07	0,55	2,31	4,03	0,04
T14. mechanical equipment	0,13	0,27	0,93	3,24	1,06	2,71	1,07	2,18	— 0,27	1,45	3,34	17,02	0,46	2,72	0,12	1,99		0,78	0,66	0,13	0,28
T15. electrical equipment	— 0,06	0,03	1,51	0,77	— 0,38	0,34	— 0,17	— 0,07	— 1,07	— 0,08	— 0,22	2,94	22,12	3,23	25,43	1,94	— 0,03		0,02	0,07	
T16. land transport equipment				— 0,03	0,05	0,03		0,01	— 0,45	0.07	— 1,58	0,64	— 0,14	— 0,43	0,04	27,28		0,04	0,09	— 0,20	
T17. Ship building & Aircraft				0,03	0,02		0,02		— 0,14		0,04	— 0,94	—0,21	32,67	0,05	— 0,14	0,02				
T10. Glass							1,61		— 0,07		0,08	0,20	0,52		0,78	0,67	0,56			0,34	
T11. Chemicals	— 0,03	0,45	0,03	0,40	1,95	0,87	3,37	22,86	0,13	5,18	19,87	0,34	1,37		3,25	0,57	29,47	8,94	5,80	0,70	
T18. Textile & clothes			0,04	0,13		0,08			— 0,05	0,54	3,28	0,04	0,20		0,47	0,82	0,06	24,74	4,84	3,43	0,12
T19. Leather & shoes			0,02	0,01		0,02									0,15	0,08			10,12	0,08	
T20. Furniture	— 0,03		0,05	0,18		0,04	0,11		0,06	0,51	0,20			0,15	0,36		— 0,13	— 0,05	0,35	7,27	0,04
T21. paper & paper board			0,07	0,02	0,04	0,18				27,75	0,49		— 0,07			0,04	0,03	0,61	0,04	0,39	18,75
T23. rubber, plastic	0,01		0,05		0,65	0,35	0,13	— 0,04	— 0,05	0,31	2,07	1,03	0,51		4,35	4,55	0,74	0,21	6,19	4,25	0,22
T09. construction materials	0,05	— 0,05	0,11	1,82	0,72	8,51	6,62	7,68	0,64	0,18	0.09	0,23	0,08			0,05	— 0,21			0,20	
packing	0,02	0,24		0,22	0,36	2,92	7,27	1,05	0,77	0,94	1,22	0,36	0,45		2,10	0,20	6,83	1,18	1,49	1,54	0,29
unidentified	— 0,21	0,02	4.53	2,48	2,53	0,03	0,49	0,55	2,19	1,45	3,22	0,46	0,14	0,39	0,11	0,63	0,07	3,14	0,09	0,10	0,50
sub constructing	11,85	1,73	4.23	3,20	2,47	1,31	3,01	3,24	7,98	0,29	0,38	4.50	1,47	4,00	1,01	0,81	1,38	6,70	4,91	1,83	6,82
sub processing	0,43	3,74	9,80	6,97	5,96	7,91	8,07	10,19	7,80	4,88	5,38	7,63	9,42	9,50	6,36	4,60	10,40	5,77	5,40	7,03	9,37
transportation	5,52	5,14	1,85	5,37	6,03	8,91	8,61	6,41	4,69	4,71	3,73	3,32	2,70	1,24	2,29	3,01	3,65	2,53	3,23	4,89	5,87
working expenses	0,15	0,69	1,35	1,03	1,11	1,59	2,08	1,43	2,03	1,46	1,68	2,00	2,05	1,00	3,43	1,41	5,59	2,68	2,76	2,71	5,70
value added																					
net wages	0,63	2,66	15,51	19,32	17,12	22,06	34,20	18,66	27,63	20,79	28,21	22,72	27,32	22,41	18,05	21,67	20,52	27,20	26,11	25,60	35,97
employers contributions	0,21	1,02	8,75	7,23	6,48	7,75	11,72	6,96	10,69	7,15	10,57	7,74	8,77	7,37	6,32	7,94	6,68	9,32	8,79	9,15	10,84
licence, wage taxes	0,19	0,17	2,88	0,95	0,75	1,09	0,99	0,99	0,89	1,03	1,14	0,91	0,52	0,48	0,57	0,88	0,75	1,06	0,90	0,79	0,46
turnover taxes			0,05		0,01	0,45	0,01				0,03	0,06	0,05		0,37	0,10		0,23			
others taxes	0,10	15,63	1,85	0,43	0,66	0,54	0,38	0,29	0,61	0,84	0,43	0,47	0,51	0,28	0,46	0,35	0,62	0,48	0,59	0,46	1,42
gross entrepreneurial income	5,09	5,15	24,46	— 2,05	— 4,63	14,02	0,42	— 2,39	12,13	4,62	8,46	7,11	13,74	5,66	8,04	3,60	8,37	1,39	7,24	2,93	0,83
Total	100,00	100,00	100,00	100,00	100,00	100,00	100,00	100,00	100,00	100,00	100,00	100,00	100,00	100,00	100,00	100,00	100,00	100,00	100,00	100,00	100,00
Salaries	0,77	0,47	3,82	5,08	3,85	5,47	8,74	4,05	7,48	4,85	8,77	6,20	6,81	4,82	7,40	6,23	5,07	10,17	11,78	9,20	9,58
Capital	77,31	31,50	294,40	109,51	81,83	113,53	76,14	92,08	26,43	68,43	69,30	30,63	49,73	44,81	36,83	47,38	37,26	42,86	42,60	42,20	42,18

Table 7 :

Commodity x Commodity matrix

(econometric model (b) ; associated T of student)

Products \ Industries	T 04 Mineral Solid Fuels	T 05 Petroleum & natural gas	T 06 Electricity, gas water	T 07 Iron and Steel	T 08 non ferrous metals	T 09 Construction materials	T 10 Glass	T 11 Basic chemicals	T 13 foundry & metal working	T 21 paper & paper board	T 23 Rubber, plastic	T 14 Mechanical equipment	T 15 A Electrical equipment	T 17 Ship building & Aircraft	T 15 B Household Electrical equipment	T 16 Land Transport equipment	T 12 Parachemicals & pharmaceutics	T 18 Textile & clothes	T 19 Leather and shoes	T 20 Furniture	T 22 Printing & publishing
TO1. Agriculture		— 0,01		— 0,01	— 0,01	0,06	— 0,02	0,54	0,03	14,83	— 0,32	0,03	— 0,21	— 0,04	0,01	— 0,02	0,22	0,44	— 0,03	13,98	— 0,05
TO2. 03. Food & Agricultural industries		— 0,05	— 0,01		— 0,15	— 0,05	0,01	4,86	— 0,01	0,50	0,11	— 0,02					3,60	— 0,03	9,01	0,52	
TO4. Solid Mineral fuels	27,69	0,08	8,21	28,71	2,19	1,61	0,01	1,72	—1,64	0,07		— 0,50	— 0,05	0,05	0,13	0,41	0,19	0,21	0,02	— 0,01	
TO6. Electricity, gas, water	0,02	1,54	2,77	16,72	17,85	11,38	6,99	16,02	3,88	4,00	4,85	3,04	2,50	1,70	1,42	4,85	1,91	3,26	0,86	2,36	1,06
T12. Parachemical	0,01	0,06	0,83	2,70	0,76	2,13	0,20	0,84	2,79	1,25	0,79	1,92	1,37	1,18	4,28	5,28	6,14	1,54	1,22	11,81	2,47
TO5. Petroleum products	0,01	78,49	13,18	1,37	0,63	3,33	1,17	9,30	0,12	1,05	0,48	0,29	0,07	0,19	0,01	0,45	—0,19	0,29	0,12	0,15	0,01
TO7. Iron & steel	— 0,13	0,01	0,27	26,40	— 0,13	0,98	0,25	0,04	6,58	— 0,08	2,03	7,81	1,31	3,24	2,12	9,04	— 0,02	— 0,08	— 0,05	0,60	0,04
TO8. non ferrous metals	— 0,06	0,02	2,22	6,47	36,44	0,24	0,34	0,95	3,77	0,14	0,41	0,87	5,32	1,09	2,45	1,86	0,70	— 0,02	— 0,02	1,09	0,06
T13. foundry & metal working	0,03	0,08	1,37	4,53	0,54	0,23	0,76	0,82	2,64	0,56	1,02	15,32	4,94	5,74	4,75	17,30	0,07	0,62	1,23	2,72	0,02
T14. mechanical equipment	0,03	0,77	1,76	5,91	0,95	2,40	0,76	3,61	— 0,22	1,11	3,42	24,54	0,81	3,94	0,09	4,52	— 0,01	0,80	0,32	0,08	0,14
T15. electrical equipment	— 0,01	0,07	2,42	1,19	— 0,29	0,25	— 0,10	— 0,10	— 0,74	— 0,05	— 0,19	3,58	32,90	3,95	17,05	3,71	— 0,03	— 0,01	0,01	0,04	
T16. land transport equipment		—		— 0,04	0,03	0,02	— 0,01	0,01	— 0,25	0,04	— 1,11	0,64	— 0,17	— 0,43	0,02	42,45		0,03	0,03	— 0,08	
T17. Ship building & Aircraft				0,04	0,01	— 0,02	0,01		— 0,10		0,03	— 1,14	— 0,31	39,58	0,03	— 0,27	0,01	— 0,01		— 0,01	
T10. Glass				— 0,04	— 0,11	— 0,02	6,24	— 0,01	— 0,30	— 0,05	0,46	1,54	5,03	— 0,11	3,36	8,31	2,86	— 0,02	0,04	1,15	
T11. Chemicals		0,85	0,03	0,48	1,14	0,50	1,57	24,72	0,07	2,59	13,28	0,32	1,57		1,68	0,84	17,94	6,01	1,83	0,28	
T18. Textile & clothes			0,12	0,35	— 0,03	0,10	0,01		— 0,06	0,60	4,89	0,09	0,52	— 0,03	0,55	2,69	0,08	37,10	3,41	3,07	0,08
T19. Leather & shoes			0,21	0,08	— 0,01	0,11			0,05	— 0,04	— 0,03	0,09	0,01	— 0,02	0,72	1,14	— 0,01	0,13	30,12	0,29	
T20. Furniture	— 0,02		0,32	1,10	— 0,04	0,11	0,26	0,06	0,17	1,30	0,67	— 0,07	— 0,01	0,72	0,95	0,05	— 0,40	— 0,16	0,57	14,94	0,06
T21. paper & paper board			0,27	0,06	0,08	0,29	0,02	— 0,02	— 0,03	40,20	0,95	0,01	— 0,24			0,16	0,05	1,18	0,03	0,45	17,81
T23. rubber, plastic			0,21	— 0,02	1,42	0,77	0,23	— 0,18	— 0,10	0,58	5,23	3,66	2,20	0,07	8,48	25,34	1,70	0,53	7,37	6,42	0,27
TO9. construction materials	0,02	— 0,19	0,29	4,42	0,85	10,05	6,28	16,98	0,70	0,18	0,12	0,43	0,19	— 0,04	— 0,01	0,16	— 0,26	— 0,01	0,01	0,17	
packing	0,01	2,28	0,01	1,29	1,03	8,41	16,79	5,68	2,03	2,33	4,07	1,69	2,58	0,02	5,40	1,48	20,71	3,97	2,34	3,07	0,47
unidentified	— 0,08	0,07	13,59	7,15	3,58	0,05	0,55	1,45	2,84	1,76	5,22	1,04	0,39	0,90	0,14	2,27	0,10	5,13	0,07	0,09	0,39
sub constructing	3,35	5,55	8,94	6,50	2,45	1,30	2,39	5,99	7,26	0,25	0,43	7,23	2,89	6,45	0,89	2,06	1,44	7,70	2,65	1,26	3,81
sub processing	0,08	8,18	14,17	9,69	4,05	5,34	4,37	12,88	4,86	2,85	4,20	8,39	12,63	10,49	3,84	7,95	7,40	4,53	1,99	3,30	3,59
transportation	2,58	27,21	6,47	18,07	9,92	14,56	11,30	19,59	7,07	6,65	7,04	8,83	8,77	3,31	3,35	12,57	6,29	4,81	2,89	5,55	5,44
working expenses	0,15	7,51	9,69	7,12	3,74	5,32	5,59	8,97	6,27	4,23	6,51	10,90	13,61	5,46	10,28	12,08	19,71	10,42	5,04	6,29	10,81
value added																					
net wages	0,11	5,50	21,20	25,40	11,01	14,08	17,54	22,30	16,27	11,48	20,84	23,62	34,66	23,38	10,32	35,39	13,81	20,22	9,11	11,35	13,02
employers contributions	0,10	5,74	32,57	25,89	11,35	13,47	16,37	22,65	17,14	10,75	21,25	21,92	30,31	20,95	9,85	35,30	12,24	18,87	8,35	11,05	10,68
licence, wage taxes	0,47	4,73	52,57	16,60	6,46	9,27	6,76	15,79	7,00	7,59	11,23	12,70	8,89	6,69	4,38	19,28	6,78	10,52	4,20	4,70	2,24
turnover taxes		0,01	0,47	— 0,03	0,05	2,12	0,02	0,01	— 0,02	— 0,04	0,18	0,43	0,48	— 0,02	1,54	1,23	— 0,01	1,28	— 0,01	— 0,02	
others taxes	0,02	33,03	2,59	0,58	0,44	0,35	0,20	0,36	0,36	0,48	0,33	0,50	0,66	0,30	0,27	0,59	0,43	0,37	0,21	0,21	0,53
gross entrepreneurial income	0,55	6,33	19,88	— 1,61	— 1,77	5,32	0,13	— 1,70	4,25	1,52	3,71	4,40	10,36	3,51	2,74	3,50	3,35	0,61	1,50	0,77	0,18
Total	**100,00**	**100,00**	**100,00**	**100,00**	**100,00**	**100,00**	**100,00**	**100,00**	**100,00**	**100,00**	**100,00**	**100,00**	**100,00**	**100,00**	**100,00**	**100,00**	**100,00**	**100,00**	**100,00**	**100,00**	**100,00**
Salaries	1,60	7,36	45,49	16,27	5,92	8,19	4,41	12,43	1,76	4,27	5,79	17,64	23,67	13,78	11,58	27,89	9,34	20,70	11,26	11,16	9,51
Capital	0,38	2,64	14,29	18,31	6,77	9,56	17,28	13,25	12,06	7,33	17,74	3,60	7,13	5,24	2,38	8,75	2,83	3,60	1,68	2,11	1,73

Conclusion

1. The intrisic analysis of I - O - tables obtained by the methods is no easy matter : the points of comparison are often lacking and the input-output table of national accounts which provides the nearest reference is constructed within a different conceptual framework from the one used in private accounting and adopted here.

However, the methods proposed here make it possible to deal with problems relating to the diversification of industries and to the accounting transition from industries to branches, once difficulties with integrated firms and, to a lesser degree, with the evaluation of changes in stocks by commodity, are resolved. The results are indeed plausible. The evaluations of coefficients are of like magnitude as those provided by national accounts and discrepancies can often be explained by conceptual differences. Finally, when their assumptions are similar, both methods, algebraic and econometric, give comparable results, which is an additional indication of their validity. They can be used for a threefold purpose :

- in order to give an image of the structures of production within the different sectors of economic activity and for the totality of large firms ;

- more particularly, to evaluate the technical coefficients of branches and the interindustry flows when there is no specific survey on this point ;

- finally, to establish, at least roughly, income statements by branch.

2. Each of the methods has its positive and negative aspects, which in fact makes them complementary :

a - the algebraic method has the indisputable advantage of being easy to apply and to work directly on industries, hence on the total population of firms. The different technological assumptions which can be introduced allow for some flexibility. It makes it possible, in the same time, to correct basic data more easily in order to take into account integrated activities.

b - On the contrary, the econometric method presents the advantage of working on simple units which are more detailed and hence, of permitting a more accurate allocation of inputs to outputs. Above all, it gives the economist an idea of the dispersion of an input coefficient. It brings out immediately the outlying firms (with respect to the proposed technology assumptions) and thus allows a study of the productive structures at the level of the firm itself.

However, it is rather hard to handle when there is a large number of firms ; though it allows for different technological assumptions (commodity-technology, industry-technology, a priori constraints...), it often requires a return to the very sources as soon as a problem appears.

c - Both advantages (manageability and precision) can be associated in the construction of an input-output table. The task of drawing a general sketch of branches at a relatively rough level (100 commodities for example) rests upon the algebraic method ; the econometric method then intervenes to procede on a more refined level (600 commodities), this time going directly to individual firm data.

3 - It should be noted, that these methods do not exclude the integration of information other than firms' accounting data used by them : various statistical data on commodities, expert advice on technologies... can be taken into account, at one stage or another of their utilization.

4 - Lastly, the application of these methods, which is at the same time a study relating to the concept of branch, also brings out the advantage of the notion of industries in analyzing production, for instance through industry x commodity tables for inputs as well as outputs. It shows the strict and at times somewhat unrealistic character of the branch concept - for example in the correspondance between branch and production technique - apprehensible only through a model. Very often, the economist would rather use industry data, statistically obtained, than branch data constructed on the basis of technological assumptions as was the case in this study.

ANNEX 1

An example : branch T 23 "Rubber, plastic"

We present herewith the application of both methods to a specific branch, T23 : "Rubber, plastic", selected because of the good coverage of the industry in the sample. For this branch, table 8 takes up the various input coefficient estimates, besides the "industry coefficients" and the coefficients adopted by official national accounts (current price accounts, exclusive of deductible VAT, of the year 1975).

Generally speaking, there are sizeable discrepancies between estimated coefficients and those of national accounts, even if magnitudes remain within the low range. Thus, the coefficient of commodity T23 (intra consumption of the branch) is far higher in the national accounts (6.38 %, column 5) than those obtained by the econometric method (2.10 % in model column 7) and by the algebraic method (2.06 % within the hybrid technology column 4). Such a confrontation may seem disappointing, but we must take into account two aspects of the question : on the one hand, the methods have been applied only to a sampling of firms which did not cover the whole industry. On the other hand, and above all (as we pointed out earlier) the I - O table of the national accounts must take into consideration activities (productions which are not traced in the sales, and intermediate consumptions which are not traced in the purchases), as well as stored productions and purchases.

The 'Rubber, plastic" example confirms, at least in part, the validity of this explanation. Indeed, it is most often activities which are close to the principal activity which are integrated, activities listed under the same nomenclature item, or activities located immediately "upstream" or "downstream". They therefore appear (as far as intermediate consumptions are concerned) either in the intraconsumption of the branch (which includes the successive intermediate productions, in the event of a vertically integrated production sequence), or in the consumptions of the chief raw materials used. This is indeed what is observed in the table (lines 15, T11 : chemicals, and 20, T23, rubber plastic).

Secondly, the best results are obtained when the models are best specified : hybrid technology assumption in the algebraic method, size effect-corrected econometric model (model b), in which quality is judged through the precision of the estimate.

TABLE 8

Input coefficients in "Rubber Plastic"

Models / Commodity	industry technical coefts	Technical coefficients: industry technology	commodity technology	mixed technology	French I.O. Table 1975	model (b)	model (b) significant coefts	model (b) non negative coefts
T01. Agriculture	0,02	0,11	-0,17	0,02	0,77	-0,15		
T02. 03. Food & Agricultural industries	0,08	0,10	-0,01	0,03		0,04		0,04
T04. Solid Mineral fuels	0,23	0,24	0,04	0,02	0,07			
T06. Electricity, gas, water	1,94	1,95	1,95	1,85	2,48	1,93	1,96	1,97
T12. Parachemical	0,32	0,36	0,26	0,32		0,22		0,22
T05. Petroleum products	1,54	1,55	1,30	1,22	1,87	1,07		1,09
T07. Iron & steel	3,90	3,94	3,56	3,74	2,31	3,45	3,50	3,52
T08. non ferrous metals	0,55	0,91	0,42	0,49	0,22	0,44		0,45
T13. foundry & metal working	1,17	1,39	0,78	1,18	0,94	0,91	0,92	0,93
T14. mechanical equipment	3,46	3,26	3,42	3,52	0,73	3,34	3,39	3,41
T15. electrical equipment	0,07	0,24	-0,26	0,06	0,35	-0,22		
T16. land transport equipment		1,02	-0,94			-1,58		
T17. Ship building & Aircraft			0,01			0,04		0,04
T10. Glass	0,14	0,16	0,14	0,15	0,78	0,08		0,08
T11. Chemicals	17,52	16,16	19,46	17,80	22,65	19,87	20,18	20,27
T18. Textile & clothes	3,49	3,48	3,50	3,48	2,36	3,28	3,33	3,35
T19. Leather & shoes	0,09	0,12	0,01	0,05		-0,01		
T20. Furniture	0,28	0,26	0,28	0,29	0,05	0,20		0,20
T21. paper & paper board	0,90	1,08	0,61	0,90	0,58	0,49		0,50
T23. rubber, plastic	1,97	1,98	2,06	2,06	6,38	2,07	2,10	2,11
T09. construction materials	0,19	0,29	-0,04	-0,04	0,17	0,09		0,09
packing	1,19	1,19	1,25	1,22		1,22	1,24	1,24
unidentified	3,00	2,80	3,35	3,08		3,22	3,27	3,29
sub constructing	0,87	1,03	0,43	0,70		0,38		0,39
sub processing	5,57	5,64	5,28	5,41		5,38	5,46	5,49
transportation	3,80	3,84	3,75	3,71		3,73	3,79	3,80
working expenses	1,75	1,78	1,71	1,76		1,68	1,71	1,71
value added	37,06	45,10	47,84	46,96	50,82	48,84	49,14	49,81
net wages	22,66	26,65	27,89	27,44		28,21	28,65	28,77
employers contributions	7,48	9,90	10,48	10,25		10,57	10,74	10,78
licence, wage taxes	0,51	1,09	1,14	1,11		1,14	1,16	1,16
turnover taxes		0,05	0,04	0,04		0,03		0,03
others taxes	0,29	0,44	0,42	0,43		0,43		0,44
gross entrepreneurial income	6,12	6,97	7,87	7,69		8,46	8,59	8,63
TOTAL	100,00	100,00	100,00	100,00	100,00	100,00	100,00	100,00

Also to be noted :

. The econometric method never brings out significantly the very low coefficients. One may wonder if it is relevant to make assumptions on the statistical distribution of residuals, and hence to take into consideration the student' Ts in the analysis of the results.

The results carried over to column 8 of the table take up all the coefficients, setting the negative coefficients at zero and renorming to 1 the income statement of the branch. Elimination of the negative coefficients influences the coefficients of the other branches, but not those of branch T23 (1) ;

. The algebraic method yields, for branch T23, higher values for the low coefficients, but, on the other hand, lower values for the high coefficients. That is why the value added rate is lower with the latter method than with the econometric method (46.96 % as against 49.81% with the econometric method and 50.82 % in the national accounts).

It is also interesting to compare the variations in coefficients brought by the adoption of such and such a technological assumption in each of the methods.

For the algebraic method, the range of magnitudes of most of the technical coefficients, whether they were obtained through one or the other of the assumptions, are the same. However, the share of intermediate consumption (and, thus the share of value added) in production are appreciably modified when we go from the industry over to the branch. It moves by about 10 % whatever the technology assumption. And, indeed, the items in the branch income account differ rather appreciably from those of the industry, more particularly the share of wages and social security contributions.

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(1) In all rigor, elimination of the negative coefficients must be a simultaneous operation on all I-O table rows. Then, the non-negative coefficients of branch T23 must themselves be affected.

Results obtained with the hybrid technologies, which seem the best, are very much affected by the choices of technology made for the different productions of industries. This choice must therefore be made with especial care, by examining the techniques and the purchases of firms.

As far as the econometric method is concerned, its findings are the closest to those derived from application of the hybrid technology, when correction (b) for heteroskedasticity is applied. The value of the coefficients are quite comparable, with this advantage to econometric approach to give some idea of the associated uncertainty.

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THE COMPILATION OF INPUT-OUTPUT TABLES IN DEVELOPING COUNTRIES

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1.0 Introduction

This paper deals mainly with problems in compiling input-output tables for developing countries, based on the experience of the authors in undertaking such studies. However the theme of the paper, to which the discussion of these problems of compilation is directed, is the relation and interaction between input-output accounts and national accounts, and the potential role of input-output tables and accounts in the evolution of a developing country's national accounting system.

We begin with a short outline of the status of input-output tables as an element in a wider system of national and social accounts, and then discuss briefly the role of such a system in development planning. The main part of the paper which follows identifies and discusses a number of important problems in the compilation of input-output accounting data and their reconciliation with the national accounts. The paper concludes with some observations and recommendations on the development of integrated input-output/national accounting systems.

2.0 Input-Output and Systems of Social and National Accounts

The last fifteen years have seen considerable progress in the integration of input-output tables and the conventional system of national accounts. At the same time the conceptual basis of the input-output accounting system - specifically, its representation in matrix form - has influenced the framework and form of presentation of the national accounts. These developments, primarily due to Stone and colleagues at the Cambridge Growth Project, are reflected in the United Nations recommended System of National Accounts (SNA), (United Nations, 1968), and in the widespread development of Social Accounting Matrices (SAM), also originated at Cambridge, (Cambridge, 1962).

A simple form of SAM is illustrated in Figure 1, which contains four basic accounts - Production, Consumption, Accumulation and the Rest of the World. Rows represent receipts, while columns represent expenditure outlays, and for any row the sum of receipts must equal the sum of expenditures. Each of the four basic accounts may be disaggregated to record the receipts and expenditure of different groups of transactors - thusthe Consumption and Accumulation accounts may distinguish Households, Busi-

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Compilation of Input-Output Tables. Edited by J. Skolka.

Figure 1 A Simple Social Accounting Matrix

RECEIPTS \ EXPENDITURES	Production Commodities and Industries	Consumption Households, Business, Government	Accumulation Households, Business, Government	Rest of World
Production Commodities and Industries	Inter-industry flows of commodities	Current consumption of final buyers	Investment expen-diture	Exports
Consumption Households, Business Government	Factor incomes	Transfers		
Accumulation Households, Business Government		Savings	Capital transfers	Net capital flows
Rest of World	Imports	Net flow of factor incomes		

ness and Government, while the Production account may distinguish individual sectors of the economy, and commodity x commodity and industry x industry flows. Within the constraints imposed by the basic accounting identities, the structure of social accounting matrices is highly flexible and its particular form may be varied to suit appropriate circumstances. The top-left cell, which embraces the flows of intermediate goods and services, is the particular focus of attention in this paper, and an elaboration of this part of SAM is shown later in Figure 3.

Two points may be made here. Firstly, SAM provides an excellent framework - theoretical and practical - for the compilation and presentation of a comprehensive system of national and social accounts; it ensures consistency in the measurement and treatment of flows, it draws attention to the economic relationships between different transactions and types of account, (similar to the way in which the earlier format of national accounts was influenced by Keynesian views of macro-economic relationships), and the SAM format is a highly flexible one which can be modified (and developed) to conform to the availability of data and the resources available to collect data. In this last connection, while the availability (and perhaps more important, accuracy) of statistics in developing countries, is a serious constraint on the implementation of a SAM-type system, considerable progress in the development of Social Accounting Matrices for developing countries has been made in the past five years or so, especially by Pyatt and colleagues at the University of Warwick and the World Bank (Pyatt and Round, 1977). An interesting feature of this work has been the development or modification of the SAM framework to give emphasis to employment, income distribution and the mapping of incomes on to households. The subsequent discussion of problems of input-output compilation in this paper should be seen as a contribution to the development of the type of SAM pioneered by Pyatt and others, albeit focussing on a small segment of the system.

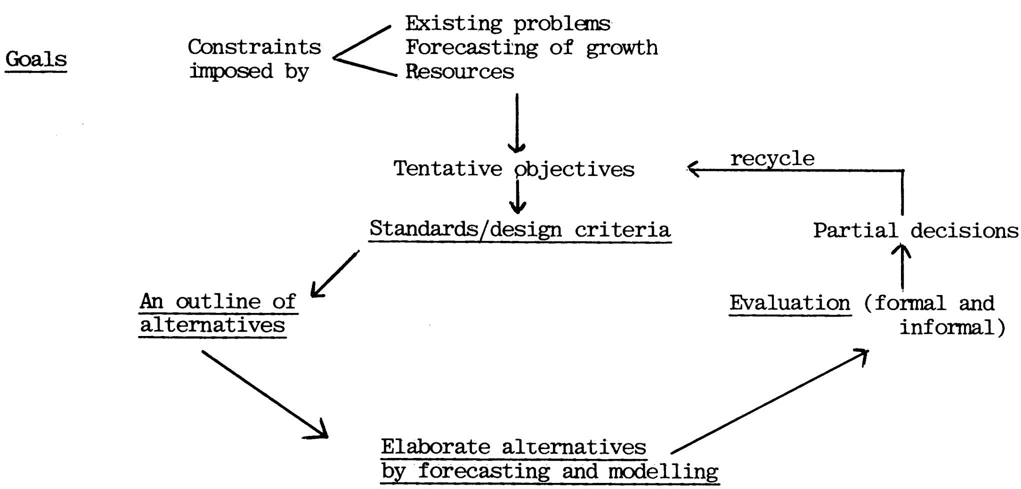
The second point, which was touched upon above and will be elaborated below, concerns the relation between the social accounting matrix and development planning.

3.0 The Use of Accounting Models in Development Planning

The design of any planning model is clearly very much influenced by the purposes for which the model is to be used, the data and resources available, and the time horizon within which a particular study has to be completed. As emphasised already, the social accounting approach is extremely flexible, and a wide range of models has been proposed. However, it would appear that, despite the range of models, the absence of standardisation in approach has not lead to a situation in which those working in the area no longer speak a common language, a fear expressed by Stone over a decade ago (Stone, 1970, p.162).

Development is a long-drawn-out process without a clear end, involving progress and investment in the economic, social and political areas. Planning is the means whereby political objectives are translated into reality. Development planning is thus a continuous process, and should be viewed cyclically rather than as a series of stages. Stages will be present - for example, the short and long-run objectives of government, the implementation of projects - but there is no final state. The planning process can be diagrammatically represented as:

Figure 2



Source: Massey and Cordey-Hayes, 1971

In such a process the elaboration of alternatives is a way of exploring and understanding the effects and implications of a wide range of objectives, assumptions, plans and policies, and is followed by an evaluation stage in which the implications of each alternative are assessed. This provides the basis for decision making (i.e. the action needed to implement the plan or part of it) and the reformulation of objectives.

Accounting models are most valuable at the forecasting and modelling stage where they can be used as a tool of analysis which forms the link between the abstract variables in a formal theory and the body of observable information (Leven, 1964). One of the problems in planning is that our ability to develop complex models is further advanced than our ability to implement them. An accounts approach does not preclude the development of additional models, but at least the adoption of the approach ensures that a consistent data set will be organised, and that gaps in the data will be revealed. Indeed, one of the major strengths of an accounting approach is its value in helping

with the development of a broader based information system for use in planning, a system which, like the planning process as a whole, involves continuous revision and regular up-dating.

It is in this context that accounting models, and in particular input-output models, should be evaluated. In this paper we are concerned with the value of these models in practice, and not with the elaboration of highly disaggregated theoretical models. The intention is to show how the input-output model is important as a basis for data collection and organisation, and to show how the approach has implications for national accounts estimation. From a theoretical point of view we would agree with Usui, who stated that, "The shifting from an input-output table to the aggregates of national income accounts raises no questions", (Usui, 1972, p.101). From a practical point of view we would contend that the position is somewhat different, and it is a practical perspective which is adopted in this paper.

4.0 The Compilation of Input-Output Tables in Developing Countries

Given the economy-wide approach of input-output analysis, and the fact that intermediate and final consumption, value added, investment and foreign trade must all be identified, in no country would an exercise to construct an input-output table have to begin in a complete vacuum. Some data will almost always be available, although the various components may be inconsistent, may relate to different time periods and may be partial in their coverage or use incompatible classification schemes. The major value of the input-output approach in the context of data assembly is the consistency which it imposes at whatever level of aggregation is adopted. In order to construct an input-output table, some survey work will inevitably be required, but it is essential that such surveys are seen as part of an overall effort to improve the regular statistical programme of a country and not as an end in themselves.

The United Nations System of National Accounts (1968) includes a comprehensive review of the methodology of input-output models, including an examination of classification schemes, the valuation of flows, the basic tables of the system, and the ways in which models can be constructed. The aim is to ensure standardisation in definitions used between countries with market economies. Whilst such standardisation is important in terms of national accounts data, it is less important insofar as the construction of input-output tables is concerned, and, indeed, may even appear to reduce the flexibility of the input-output approach.

The construction of an input-output table, and the implementation of an information system are issues which cannot be separated from a consideration of the model or models which are to be developed. The relevance of any particular piece of data will be determined by the requirements of the model to be used, but we would very much

support the arguments of Pyatt and Round, who write:- "We do not see model construction as the primary task even though the model (or models) is ultimately pre-eminent. In our view progress is to be made by iterative - or better, simultaneous - attention to a priori or model considerations on the one hand and empirical measurement and calibration on the other." (Pyatt and Round, 1977, p.362).

We take as our starting point the recommendations in the SNA with respect to input-output analysis. The SNA distinguishes between accounts on commodities and accounts on activities. Accounts on commodities show the origins and destinations of the supply of commodities, commodity supplies coming from domestic production and imports. Accounts on activities show the sales and cost structures of the domestic production of goods and services. The relationship between the major accounting blocks included in the SNA can be simplified and the structure can be presented as shown in Figure 3, where an upper case figure denotes a matrix, a lower case letter a column vector and a Greek letter a scalar. (For a more comprehensive discussion see Aidenoff (1970) or Stone (1970)).

Figure 3 The Input-Output Data in the SNA

	Commodities	Industries*	Final Buyers Net	Totals
Commodities		U	e	q
Industries	V			g
Value added		y'		η
Totals	q'	g'	η	

*Note: We define industry in a wide sense to include government and non-profit institutions, utilities, construction, agriculture and services.

In Figure 3 vectors are column vectors and a row vector is indicated by the use of a prime superscript (′). Thus

- U = Absorption of commodities as intermediate inputs by industries (dimension $j \times k$, where there are j commodities and k industries)
- e = Net final use of commodities (dimension $j \times 1$)
- q = Domestic output of commodities ($j \times 1$)
- V = Production of commodities by industries (dimension $k \times j$)

g = Domestic output of industries (k x 1)

y' = Primary inputs (value added) of industries (1 x k)

η = Sum of value added in each industry = Sum of net final demand for each commodity

If we define the unit column vector (i):

Ui = Total intermediate demand for commodities

$$q = Ui + e \quad (1)$$

$$g = Vi \quad (2)$$

The matrix U is generally known as an absorption matrix, and the matrix V is generally called a make matrix. V is strongly diagonal, since a typical element V_{kj} shows the production of commodity j by industry k, and industries by definition produce most of their characteristic products. The off-diagonal elements in V show the amount of secondary production. The ways in which secondary production can be dealt with are considered below, but for the time being we consider the problems in assembling the data needed to complete the building blocks of Figure 3.

In many developing countries it may be that the only data available relate to national income. Gross domestic product can be defined as the sum of value added in the different sectors ($=\eta$). It is possible that there may be some disaggregation, so that control totals may be available for certain elements or groups of elements in y'. In addition, some of the data relating to net final buyers may also be available (exports, imports, investment), but again the sectoring schemes used may not be appropriate. The arrangement of input-output data as recommended in the SNA is best seen as a long-term goal, and what is presented here is a summary of the major difficulties which have to be resolved en route to that goal.

These difficulties concern the following issues (not presented in any order of significance since they are likely to vary from country to country): data collection, data processing, valuation of flows, commodity balances, secondary production and the treatment of external trade.

Included under the general heading of data collection are a wide range of other issues. Given the poor quality of data in many developing countries, it is often the case that there are inconsistencies even in the aggregate statistics which may have been assembled. A major problem thus concerns control totals for the sectors to be included in the model. Figures showing gross output or even employment by sector may not be available, and registers showing the numbers and sizes of establishments may only exist in rudimentary form.

The implication of this is that if field surveys are to be undertaken, a complete census is preferable to a sample, so that the data which are collected can be assumed to be reliable. Sampling under conditions involving such uncertainty is not possible, and any scale factors adopted to gross-up the data would probably be arbitrary. However, given that a census will be necessary, and given that the resources for a complete census of all sectors to allow the complete implementation of the SNA system will not be available, how should the sectors to be surveyed in the field be selected?

Two issues are important here. One is the way in which data collection is organised in the country in question, and the other concerns the short-term objectives of the exercise which invoked the decision to instigate the SNA approach. Perhaps a more pertinent question concerns the way data collection ought to be, rather than is, organised, since the long term goal should be the overall improvement of the national data base. Most developing countries have a central statistical agency, although data collection may involve several ministries or government departments. The involvement of various organisations in data collection is often one of the main reasons for inconsistencies in data sets, so there is clearly a requirement at least for some form of co-ordination. In addition, given the manpower and computing resources which are generally available, it is probably advisable to undertake only one major field survey each year, at least until the data base can be established. The major surveys needed for the construction of an input-output data base (and for the compilation of reliable national accounts) are best organised on a sectoral basis and so over a five-year period the following major surveys might be carried out - agriculture, mining and manufacturing (including utilities), construction, services, households and tourists. The point to note is once a definitive census has been undertaken, it is always possible to undertake sample surveys in subsequent years to monitor changes in the system and up-date information assembled.

In the absence of any definitive data the sectors for which the first census is undertaken will be determined by the planning priorities, but in most cases manufacturing industry will be examined first. This is because most development planning ultimately involves the identification of new manufacturing projects, and also because the manufacturing sector - however little developed - is central to the economic system and has links with most other intermediate sectors and final demand.

A census of manufacturing is also useful in piecing together control totals for other sectors whose output is consumed by manufacturing or which consume the output of the manufacturing sector. It will not provide all the data necessary for the construction of an input-output table, but it will begin to reveal the major problem areas and inconsistencies present in other data sets, especially as data on manufacturing can be combined with data on external trade, statistics which exist for almost all countries.

Before such global conclusions can be drawn the data have to be processed and presented in summary form. Data processing should be computer based, and the validation of any questionnaire returns should be a major part of any input-output exercise. Errors present in the basic data inevitably lead to problems at later stages, when the source of such errors is more difficult to detect. Effort spent in validating data is thus always a sound investment, and errors in coding and card punching can usually be detected by including formal checking procedures in the routines developed.

More difficult to detect are the errors introduced by respondents themselves, even when detailed questionnaires have been completed in the field by a trained member of a survey team. In our experience such errors are best detected by computing summary statistics for each establishment or respondent. Such summary statistics might include value added, gross output, capital employed, or investment expenditures, shown in absolute terms and in standardised form (e.g. value added per worker). Within any defined group means and standard deviations can then be computed for each of the indicators, so that further checks can be made on the accuracy of data in what appear to be unusual questionnaire returns. Where necessary further field visits can be made.

One of the major problems in compiling input-output tables in developing countries concerns the valuation of flows. The SNA recommends that flows be expressed in terms of producers' prices. Producers' prices are the farm or factory gate prices, and so include any net indirect taxes which are levied on production before the commodities have left the producers, but exclude any trade or transport margins added subsequently. For services, trade and transport margins do not apply, but for all other producing sectors the estimation of trade and transport margins is one of the diggest difficulties to be faced.

If trade margins are to be measured, even approximately, two pieces of information are required for each commodity. One is the proportion of production passing through the trade sector, and the other is the average margin charged on the commodity in question. Even when the results of a trade survey are available, the allocation of margins is difficult, since the purchasing pattern of industries varies. Some industries will buy all their supplies of a particular commodity from a wholesaler, whereas others will buy direct from the producer.

The major argument in favour of using producers' prices is that these most closely reflect the technical structure of an economy. In theory this is true. In practice, the allocation of margins in developing countries, even when a trade survey has been carried out, is complicated, so that some 'guesstimates' have inevitably to be made. A solution is to construct the absorption matrix in terms of purchasers' prices, and to use this as a base for subsequent modelling work.

This leads on to the question of commodity balances. We have seen above (equation (1)) that the domestic output of commodities is equal to the intermediate demand plus net final demand for those commodities:

$$q = Ui + e$$

where

q = Domestic output of commodities

U = Absorption of commodities by industries

e = Net final demand

i = Unit column vector

If the matrix U is expressed in terms of purchasers' prices, it will usually be the case that the vector q is expressed in terms of producers prices, especially if a survey of manufacturing has been undertaken. Thus, in order to secure a balance, an additional term has to be added to the euqation:

$$q = Ui + e - m \qquad (3)$$

where

m is a vector of margins on the commodities

In making the commodity balance, numerous modifications will have to be made to the basic data. Many of these modifications will be small, but some sectors will appear more intractable than others. These sectors usually fall into two categories. The first concerns commodities which are difficult to allocate to an exact ISIC group (assuming the International Standard Industrial Classification is being used). Chemical products almost always pose problems in this respect, and the greater the disaggregation the more severe the problems. Confusion also surrounds the separation of agricultural products from those of the food processing industries, and is also commonly found in metal processing sectors. This confusion might also extend to the external trade statistics, where there is no guarantee that the correct allocation of commodities to sectors has been made.

The second group of problem sectors concerns those sectors with a high proportion of small scale establishments. Bakery and other food products and clothing are perhaps

the prime examples, but many others from quarrying to metals may be affected, especially if there is a strong artisan tradition. Most commodities produced by small establishments will be sold direct to final consumption, which simplifies the problems to some extent, but in the absence of a survey of household consumption 'guesstimates' may have to be made here.

In preparing commodity balances a useful rule of thumb is to allocate sectors into two categories. One category will consist of those sectors which are particularly important or easy to distinguish. Such sectors may be the major export earning sectors, or may involve only one or two key establishments. Usually several such sectors exist in developing countries, and it is good practice to achieve a commodity balance for these sectors first. This then gives a datum which is helpful in making estimates and balances for other commodities, which constitute the second category. Preparing commodity balances for each row will not necessarily result in a balanced input-output table. Indeed, it is most unlikely to do so, and therefore further steps have to be taken to achieve a global balance. Amending row entries will always have implications for the columns, and if any of the columns are changed it is more than likely that some adjustment will be made to value added, with consequent implications for GDP. Balancing the input-output table can be done before or after secondary production has been transferred, to which we now turn.

Secondary production of commodities by establishment is a problem which is compounded by detailed disaggregation. The problem of secondary production is one which has to be faced if the data as arranged in Figure 3 are to be rearranged to construct a square input-output table which can subsequently be used for planning applications. The aim of transferring secondary production is to produce a homogeneous commodity-by-commodity or industry-by-industry matrix. The former shows the inputs of commodities in the production of commodities and the latter shows the inputs from industries into industries.

The transfer of gross outputs can be achieved easily, since the off-diagonal elements in the make matrix (V in Figure 2) indicate the amount and nature of secondary production. The transfer of inputs is more difficult, and as outlined in the SNA, two approaches have conventionally been adopted, based on assumptions concerning the costs associated with the production of secondary products. One approach is based on the assumption of a commodity technology, which implies that the cost structure of the subsidiary products is the same as the cost structure of the

sector in which the items are the main products, and the other is based on the assumption of an industry technology. This suggests that the costs associated with secondary production will be a proportion of the costs of the establishment in which the secondary product is manufactured. The assumption of a commodity technology poses more problems than the assumption of an industry technology. In the former case, the number of industries has to be equal to the number of commodities (see Aidenoff (1970) or Stone (1970)). In addition, the sector to which the secondary production is being transferred might also include secondary production, so that its cost structure is not based on the production of a homogeneous good. Finally, the assumption of a commodity technology may not be possible in cases where the input is recorded in the receiving sector but is not present in the sector from which the secondary production is to be transferred. The industry technology assumption enables a more detailed classification of commodities than industries to be used, and does not suffer from the other problems associated with the use of the commodity technology assumption. For practical reasons therefore its use is preferable, at least in the first stages of any input-output exercise.

In the process of compiling the input-output accounts statistics of commodity imports and exports are very important, for two reasons. First, statistics of commodity imports and exports are often the most reliable, regular and up-to-date of all the major economic series, for a variety of reasons including their importance as a source of tax revenue, and concerns with balance of payments problems. (Historically, the foreign trade sector has often been the first area of economic activity to attract fiscal and other means of control by the authorities). Secondly, in most developing countries traded goods constitute a high proportion of total and domestic commodity supply, and thus are important in establishing control totals and commodity balances. Moreover trade data are usually available at a fine level of detail which is more disaggregated than the required classification scheme for the input-output table. Admittedly, there are often errors of classification in the trade statistics, and the system of classification used (e.g. SITC or BTN) may differ from that used for domestic production activities, so that a considerable amount of work may be required to check the data and re-classify it. Once this is done, however, the trade data can be invaluable in constructing the input-output table, in a variety of ways.

At the detailed commodity level a large proportion of imports can be identified as destined for either intermediate use or final use; and within these categories commodities can be further allocated to households or capital formation (in the case of "final" goods) or to particular sectors or groups of sectors (agriculture, construction, manufacturing) in the case of "intermediate" use. For many commodity imports, the category and even the sector of destination can be unambiguously identified; in other cases the particular commodity identified in the import statistics may include a variety

of products, some of which may be destined for intermediate use, and others for final use. In these cases a provisional allocation may be made, or the commodity may simply be listed as "unallocated".

This exercise, which should be undertaken at an early stage in the process of constructing the table, is useful in a number of ways:

- it can provide minimal (sometimes actual, where there is no domestic production of the commodity concerned) control totals for intermediate demand, which can be compared with the estimates of total intermediate demand derived from the absorption matrix:

- it can provide information on a major component of household expenditure, expecially for non-food items. This is important since unless there has been a recent or concurrent household budget survey, data on the level and pattern of household expenditure is usually sparse, and the conventional national accounts aggregates often treat household expenditure as a residual (balancing) item;

- since most developing countries import most if not all their capital goods outside construction, the import statistics are the main source of data for the capital formation vector and total investment expenditure;

- in cases where imports can be allocated to a particular intermediate user (fertilisers to agriculture, cement to construction), such information can help in the construction of particular columns of the absorption matrix, particularly if estimates of domestic output are not available or are weak.

A good example of the last point is the construction sector. The output of the construction industry, which is a major component of gross domestic product and a "leading sector" in many developing countries, is difficult to estimate accurately, for a variety of reasons, including the existence of a large number of small enterprises. In the absence of a population frame or comprehensive survey of the industry, data on the absorption of imported building materials (cement, structural steel, etc.) by the construction sector, allied with technical and/or limited survey data, can be used to estimate gross output and value added. In input-output terminology, let a_{rs} be a technical coefficient measuring the required input of (e.g.) cement per unit of output of construction, and $X_{rs} = M_{rs}$ be the total absorption of cement, met entirely by imports, of the construction industry. Then as a first approximation the output of the construction industry can be estimated as

$$\hat{X}_s = M_{rs} / a_{rs}$$

In summary, given that imports form a major part of the total domestic supply of commodities, a careful analysis of import statistics can help considerably in the balancing and reconciliation of commodity flows and the construction of the absorption matrix.

Commodity exports are less important in this regard. Nevertheless, they at least determine minimum output levels for domestic production, and a comparison of exports with estimated domestic production can often provide a "rule of thumb" guide to the accuracy of the latter estimate.

For instance the apparent share of domestic output exported may be implausibly high or low in relation to other information obtained from an industrial survey or interviews with traders.

Reference above to the construction industry draws attention to a major difficulty in compiling national income and input-output accounts for developing countries. This is the paucity of data on the non-manufacturing (and mining) sectors of the economy, in spite of the fact that these sectors account for the greatest share of national income (and an even greater share of employment). Absence of data is almost universal in the case of commerce and personal services, and common in the case of transport and construction; with respect to agriculture there is greater variation between countries - in some, good quality data are regularly available, in others the data are non-existent or poor in quality.

There is now perhaps greater acknolwedgement of the role of non-manufacturing sectors in welfare and development, and this should provoke greater attention to the compilation of statistics measuring the contribution of these sectors to domestic product. It was suggested earlier that regular surveys of the non-manufacturing sectors should be undertaken, in the form of periodic censuses with sample surveys for intervening years. An additional or alternative approach is the multi-purpose household survey, which can provide information on:

- labour force participation rates, occupational and sectoral employment
- household income and expenditure

Allied with good base-line (census) data on population and output by major sectors, such surveys can be used to estimate output and value-added in the non-manufacturing sectors, and to update the household expenditure column. This form of survey can be used to collect data which can help extend the social accounting matrix, including

the mapping of incomes on expenditure, the skill composition of the labour force and so on.

5.0 Reconciliation and Revision of National Accounts

The consistency imposed by the adoption of an accounts approach has been emphasised frequently in this paper, and this same consistency applies when national income is being estimated. The need to reconcile conflicting data sets becomes almost inevitable even if new data are assembled for only a small part of the system. The consequent revision in national income estimates poses a number of problems not the least of which are personal in that staff may be unwilling to accept fundamental modifications to data which they have prepared over many years, or may be reluctant to accept new data on a revised base which disturbs time-series work. There may also be difficulties associated with a revision of national income for the government of a developing country, in that the ranking of the country in a world league table - and consequently its credit position - may be affected.

The construction of an input-output table will inevitably lead to an improvement in national accounts data. The improvement will be most marked in those countries where no previous input-output table existed, or where only an outdated input-output table is available. Given the close relationship between the value added data in an input-output table and the definition of GDP, even an input-output table with a limited number of sectors will show the origin of GDP in more detail than the conventional way in which national income statistics data are shown.

As mentioned earlier, modifying any row in order to achieve a balance will have implications for one or more columns. In these cases it is frequently found that in order to have consistency in any column (in, for example, the ratio of total intermediate inputs to total output) an amendment will have to be made to value added with implications for GDP unless a balancing adjustment is made elsewhere in the table. Sometimes certain sectors - services or even households - are used as a sump in order to achieve global balances, or mechanical balancing techniques are used. This is not good practice, however, since there will be weak links in different parts of the table, and balancing on one sector or in a mechanical way ignores the fact that some data are better than others. Indeed, almost forty years ago, Stone (1942) pointed out that even when the precision of data cannot be measured in a formal statistical sense, it is absurd to give the same weight to all measurements when national accounts are being estimated.

At the time Stone was concerned with the estimation of national accounts data with a limited number of equations. The mathematical problems of balancing input-output tables are greater, and it would appear that the best approach is to repeat the balan-

cing exercise on a row and column basis until most of the anomalies have been removed, and the accounts as a whole are realistic. In cases where no previous input-output table is available to help estimate the constraints on the balancing process, a manual exercise (but probably requiring interactive computing facilities) is perhaps best.

Of the mathematical balancing techniques RAS (discussed fully in Bacharach (1970) is the best-known. We would suggest that the RAS approach - or a modified RAS approach involving the application of constraints on particular cells by setting these to zero, and modifying the row and column totals before scaling - is of value, but that it is best used when discrepancies in the table are small. The same applies to the other mathematical approaches* although Stone (1977) has suggested that there might be advantages in adopting a formal approach at the outset. We suspect that these approaches, which have yet to be fully tested, will prove to be more appropriate for up-dating matrices rather than for their initial estimation (as opposed to the final balancing) since the prior values are often almost arbitrary guesses where no input-output table has been previously produced.

6.0 Conclusions

The issues which have been emphasised and briefly discussed in this paper rest on two major considerations. The first is the belief that social accounting matrices provide an invaluable framework for the organisation of data and the development of a system of national and social accounting which is sufficiently flexible to reflect the needs and circumstances of individual developing countries. The second is the view that despite its relatively high resource costs, the regular compilation of survey-based input-output tables is a necessary and valuable exercise in the development and maintenance of a reliable system of national accounts. In this connection it may be noted that input-output tables compiled recently under the authors' direction for two developing countries have led to revisions in the order of 20-40% in those countries' national income estimates, and to equally significant changes in the estimated pattern of economic activity in different sectors. The very task of constructing such tables draws on virtually all available sources of economic information in a developing country, identifies inconsistencies between different data sources, and points to the main priorities for improvements in information. Provided resources are allocated to the regular up-dating of tables - regrettably this is all too rare - a permanent improvement in the quality of the national accounts can be achieved, and the foundations will have been laid for the development of the comprehensive social accounting systems outlined at the beginning of this paper.

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* These approaches usually involve the computation of a set of matrix elements expressed as linear combinations of a set of prior matrix elements, the coefficients being determined by the constraints imposed. For example see Stone (1961; 1970; 1977;), Byron (1978), Morrison and Thumann(1980), Hyman and Morrison (forthcoming).

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THE VALUE ADDED TAX WITHIN THE FRAMEWORK OF MAKE- AND USE MATRICES- THE AUSTRIAN APPROACH

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Introduction and Summary

Within the last twenty years value added tax (VAT) has replaced the more traditional systems of turnover or sales taxation in many market economies and now often represents the most important indirect tax (accounting for about 20 p.c. of total government tax revenue in Austria, eg.). Surprisingly, its peculiarities have not found as much attention in the international discussion as many other subjects important for uniform presentation in national accounts. The main problems originate from the inherent tax credit regime that brings about some ambiguity of the indirect tax element involved in an individual transaction. Additional problems are sometimes due to particular provisions of VAT-exemptions.

The present paper deals with the concept of integrating VAT into a SNA-based framework of supply and use matrices adopted in Austria (IO-Project 1976). It focusses on the primary problems of compilation and balancing the system rather than on subsequent approaches of purification or of standard IO-analysis which already presuppose the existence of the whole statistical system. Any data needed for this system should be obtainable from statistical surveys, in principle. Beyond the Austrian IO-concept aims at a maximum degree of flexibility as regards the adoption of different valuation systems in respect of indirect taxes.

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The valuation concepts recommended in SNA serve as a primary basis of reference although SNA does not provide any guidelines as regards the appropriate treatment of VAT itself. Therefore, the specific features of VAT to be integrated within production and supply and use accounts are examined in some detail, in a separate section. On this basis a "VAT system table" is exhibited which enables any concept of valuation to be derived that can be achieved by mere statistical tools, without any further estimation efforts and/or assumptions.

As regards the systematic concept the main solutions do not substantially differ from similar propositions put forward elsewhere[1]. The "aliquid novi" - element rather seems to lie in the synoptic presentation of a comprehensive system from which any feasible valuation concept may be derived as desired. At the same time, referring to such a system one may easily identify the data requirements of a certain valuation concept, and where national data would match best. Presumably a concept of approximate basic values, net of VAT turns out as most suitable from a theoretical as well as a compilation point of view.

The practical solutions for the various VAT-related submatrices of the system mainly refer to tax base matrices in standard IO-classification and tax rate vectors which are derived from often much more detailed commodity flow data.

From the authors' point of view the discussion might, inter alia, fruitfully refer to the following topics:

- availability and design of similar comprehensive VAT system matrices;
- other, divergent systems of balancing supply and use;
- actual use of gross treatments (eg. for examination of the VAT avoidance);

1) See list of references

- the problem of the VAT unit established bv law (enterprise) as against the statistical unit in the economic statistics/national accounts (establishment basis).

- practical experience from statistical attempts of quantification of VAT revenue with a view to government revenue fiqures.

It should be mentioned in advance that, unfortunately, the original time schedule of the Austrian IO-Project has been exceeded for various reasons so that it has not yet been possible to attach illustrative data to this report as originally intended.

1. Useful Definitions

Market Price Valuation: The agent which first charges an indirect tax as an element of the output price (market price) is considered as a "producer" of that tax.[2] Any indirect tax is recorded on account of the producer. Though, by definition he is not considered to bear the tax. In correspondence therewith is the concept of

Shifting - Non-Affectation of Factor Costs: Any indirect tax is considered to be shifted completely to the purchaser. Accordingly all indirect taxes will eventually be passed on to final demand and do not affect either the level nor the composition of factor costs.

Basis of Recording: The amounts of indirect tax exhibited in the commodity or in the productions accounts, respectively, are neither determined by the tax yield actually collected (cash) nor by that due to be paid. They only depend on the commodity flow figures exhibited as a tax basis in the accounts, and are to be calculated on this basis according to the effective rules of taxation (tax produced). (This procedure will in principle coincide with analogous cost accounting of the producer.)

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2) This may deviate from the fiscal situation if an establishment concept is used as regards the statistical unit (tax unit).

The Concept of VAT: Within the family of indirect taxes VAT comes under the group of commodity taxes (CT)[3]. As regards VAT terminology the following main concepts will be used.

VAT invoiced:	tax on outputs taxable under VAT rules: This is a gross concept, before any deductions owing to the inherent tax credit regime.
VAT deductible:	VAT invoiced to a producer entitled to VAT credit.
VAT payable:	VAT due on the basis of a certain output. It equals VAT invoiced by the producer minus VAT deductible.
VAT non-deductible:	VAT invoiced to a producer not (or not invariably) entitled to VAT credit.
VAT exemption:	There a producer must not invoice VAT. In the case of an incomplete exemption VAT invoiced to the VAT-exempt producer must not be deducted.

The deductibility of VAT invoiced to market producers as well as the existence of certain exemptions seem to be common to all usual VAT-Systems.

Some Austrian VAT peculiarities

The existence of a significant range of incomplete tax exemptions is an important fact for the further considerations. As pointed out earlier in these cases VAT may not be invoiced by the producer entitled to such exemption. On the other hand such a producer is not allowed to deduct VAT invoiced to him - in respect of output incompletely exempt from VAT. VAT invoiced to such a producer is

3) A System of National Accounts, UN 1968, p.95

to be treated like any commodity tax other than VAT. From this with respect to hidden VAT elements included in outnut nrices a certain "impurity" results which requires particular attention in harmonizing the accounts. This situation applies to producers of non-market services, like government, for their non-commodity sales, in particular.

The deductibilitv of VAT invoiced to the nroducer applies also to commodities purchased for fixed capital formation.

As a further peculiarity the existence of different tax rates is to be mentioned.

Other special features of the actual Austrian VAT system are not necessarily affecting the basic concept of the IO-framework and need not be dealt with here (cf. Annex also)[4]. - Requirements of the conceptive IO-framework which originate in svstematical or statistical circumstances are briefly referred to in section 4 below.

2. Relevant valuation concepts of SNA

In this section those basic concepts of valuation in the SNA are briefly resumed which may in some respect assume importance for VAT as a CT type[5]. These concepts primarily apply to an individual producing unit but may easily be transposed to an entire industry, or sector.

4) Eg. existence of an investment tax during a rather long transitional period.

5) A System of National Accounts, UN 1968, p.230.

(1) gross output at producers' prices
- commodity taxes (in respect of gross output)
= gross output at approximate basic values
- intermediate input at purchasers' values
= value added at approximate basic values = value added at true basic values

To this for value added corresponds:

(1a) primary inputs (factor costs)
+ other (than commodity) indirect taxes
= value added at true basic values = value added at approximate basic values
+ commodity taxes (in respect of gross output)
= value added at producers' prices

Obviously the data requirements of the above valuation concept can be directly met through statistical inquiry of the producing unit(s).

(2) gross output at approximate basic values
- invoiced commodity taxes in respect of direct intermediate inputs[6)]
- accumulated commodity taxes in respect of indirect intermediate inputs[6)]
= gross output at true basic values
- intermediate inputs at true basic values[6)]
= value added at true basic values = value added at approximate basic values

In this case the data on the CT directly invoiced to the producer(s) may still be obtainable at least when they are invoiced separately. However, this would by no means apply to CT accumulated in the

6) Intermediate consumption is taken as including trade and transport margins throughout.

preceding production stages.

For value added approximate basic values equal basic values [(1), (2)]. An other identity, essential for the balance of the whole system,

> "total value added = total final expenditure (minus imports)"

will only hold in case of a <u>true</u> basic valuation.[7] This might be a weak point of SNA. In the case of an approximate basic valuation (alone susceptible to statistical observation) the latter identity can be achieved only through a modification of (2), by taking into account input taxes, as follows.

(3)   gross output at approximate basic values
        - intermediate inputs at purchasers' values
        + CT directly invoiced to the producer in respect of intermediate inputs
        (intermediate inputs at approximate basic values)
        = value added at approximate basic values^{x}

In contrast to the usual approximate basic valuation, a value added at approximate basic values^{x} includes an element of CT namely those CT directly invoiced to the producer(s) on intermediate inputs. This results into a presentation where the observable indirect tax component on input is <u>shifted</u> from the supplier to the purchaser.

Besides, any approximate basic value (value^{x}) still includes some indirect tax elements: These are

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7) A System of National Accounts, UN 1968, p.67.

- indirect taxes other than CT, of any stage (the tax base is often a value added component.

- CT on intermediate inputs the amount of which is not separately shown on the invoice submitted by the supplier (or, at least, not directly identifiable bv simple calculation: indirect taxes accumulated in the preceding production stages).

Because of lacking direct surveyability stipulated before, these tax data are not available for being deducted in the compilation stage of the IO-tables.[8)]

3. VAT within a SNA-Framework

In the accounts of the statistical unit VAT invoiced and VAT payable, i.e. VAT after deduction of deductible tax invoiced to the producer can be distinguished. In such a tax credit system the tax unit is allowed to deduct from VAT invoiced by itself the amount of VAT invoiced to itself during the accounting period. As this deductibility is not invariably extended to all kinds of

8) This lack can be overcome on the basis of knowledge of the technological interlinks between the producer(s) and the direct and indirect suppliers, by means of the usual IO-model calculations. As for this the existence of the complete IO-system is presupposed this is left out of further consideration here. - As a matter of course, with a view to the desireable homogeneity of the commodity flows a factor cost valuation (or a close proxy, like true basic valuation) would be most attractive. However, facing the abovementioned impracticability of obtaining the necessary data prior to the existence of an IO-table such valuation concepts are also left aside.

producers or activities VAT invoiced to the producer can be further divided into that deductible and that non-deductible, respectively. VAT non-deductible is nothing different from any commodity tax other than VAT, i.e. it represents a cost element. In the normal situation of deductibility the producer may consider VAT invoiced to him not as a cost element but as a transitory phenomenon without any significance for pricing.

The way of accounting may, in any case, most purposefully be specified according to the general valuation concepts and system requirements of SNA. However, SNA is mostly silent on VAT and does not recommend any certain solution for the treatment of VAT except its qualification as a commodity tax. In the economic end VAT is ultimately to be shifted to final demand which can be traced back to value added. To this situation some net concept of VAT might seem to be most suitable.[9] However, even a straigt net treatment does not automatically ensure balancing accounts, and it seems useful to comprehensively examine the principal option for a producers' price as well as a basic valuation concept, therefore. The accounts presented below can easily be identified in the VAT system matrix presented in section 4, also.

A. Producers' Prices

Depending on the different extent to which non-deductible VAT is accepted as a price component three different bases of producers' prices may be distinguished.

9) Since, in most instances, not only VAT invoiced on inputs but that on investments of market producers also may be deducted the basis of taxation is even smaller than value added: PFC and final consumption and fixed capital investment of non-market producers.

a) Gross Treatment

In the gross treatment VAT is treated like as it appears in the individual transaction (invoice): each transaction is valuated gross, except those which are exempt from VAT (eg. stocks of commodities produced, exports, production of own account investment).

The accounts are accordingly arranged as follows:[10) 11)]

Production account

INPUTS		OUTPUTS	
$i(U_b+U_v+U_c)$	...intermediate inputs incl.VAT invoiced to the producer	$(V_b+V_v+V_c)i$	...outputs incl. VAT invoiced by the producer
y_f	...factor costs		
y_t	...other (than commodity) indirect taxes		
y_z	...VAT payable by the producers on their current transactions		
y_c	...other commodity taxes		
g_g'	...gross inputs at producers' values	g_g	...gross outputs at producers' values

y_z includes VAT payable with a view to output produced only,

10) For symbols see page ff.

11) Also cf. Value Added Tax and National Accounts, OECD Paris, 1976, Working Document, DES/NI/76.3 (RESTRICTED)

before any deduction of invoiced VAT other than for intermediate consumption.

Therefore y_z equals VAT payable by the producers' (y_v) + deductible VAT on gross capital formation (f_y).

Commodity account

SUPPLY	USE
$i(V_b+V_v+V_c)$...domestic supply, incl.VAT	$(U_b+U_v+U_c)i$...intermediate use, incl. VAT
m_v............VAT on imports	$(C_b+C_v+C_c)i$...consumption,incl. VAT
m_c............other import duties	$(F_b+F_v+F_c)i$...gross capital formation,incl. VAT
m_b............imports cif	
	(X_b+X_c).......exports fob
g_g'...........total supply at producers' values	g_g............total use at producers' value

b) Net Treatment

The net treatment exhibits VAT from the transactors' point of view. Depending on the deductibility of VAT invoiced on input VAT is or is not an element of the production costs. Purchases are recorded net if the purchaser is entitled to deduct the VAT invoiced to him. Otherwise, transactions are recorded gross the latter applies to PFC, in general. Since supply is valuated invariably net while use is valuated in part net, in part gross as one major disadvantage of the net treatment an asymmetry arises between the supply and use totals, owing to the different treatment of invoiced tax with a view to deductibility.[12)]

12) The supply-use discrepancy can be eliminated from the accounts by introducing a dummy ("VAT levied on products").

Production account

INPUTS	OUTPUTS
$i.(U_b+U_x+U_c)$...intermediate inputs, net of deductible VAT invoiced to the producers	$(v_b+v_c)i$...outputs,net of VAT invoiced by the producers
y_f............factos costs	
y_t............other (than commodity) indirect taxes	
y_c............other commodity taxes	
g_n'...........gross inputs at producers' values, net of VAT	g_n.........gross outputs, net of VAT

Commodity account

SUPPLY	USE
$i(V_b+V_c)$...domestic output net of VAT, invoiced by the producers	$(U_b+U_x+U_c)i$...intermediate use net of deductible VAT,invoiced to the producers
d_v.........VAT levied on products	$(C_b+C_v+C_c)i$...consumption,gross of VAT
m_c.........other import duties	$(F_b+(F_v-F_y)+F_c)i$..gross capital formation,net of deductible VAT
m_b.........imports cif	
	(X_b+X_c).......exports fob

q'_n ....total supply at producers' values, net of VAT	q_n ....total use at producers' values, net of VAT

c) Modified Gross Treatment

In this version use is valuated like in the net treatment whereas intermediate consumption is valuated gross. The inevitable supply use discrepancy may be eliminated as in (b) (deductible VAT on commodities used for gross capital formation).[13)]

Production account

(see a) above)

Commodity account

SUPPLY	USE
$i(V_b+V_v+V_c)$ ...domestic output, gross of VAT	$(U_b+U_v+U_c)i$ ...intermediate use, gross of VAT
$-f_y$ ....(negative) deductible VAT on gross capital formation	$(C_b+C_v+C_c)i$ ...consumption, gross of VAT
m_v ....VAT on imports	$(F_b+(F_v-F_y)+F_c)i$ ...gross capital formation including non-deductible VAT
m_c ....other import duties	
m_b ....imports, cif	(X_b+X_c) ....exports, fob
q_m' ....total supply at producers' values	q_m ....total use at producers' values

13) In fact the only difference from the gross treatment relates to gross capital formation.

B. Basic Valuation

Suppose a hypothetical situation of VAT representing the only CT to which the above SNA concepts are to be applied (see section 2. above) the following relation holds:

(4) gross output at producers' prices (gross treatment)
-VAT invoiced by the producer
=gross output at true basic values

Deducting from producers' values, gross of VAT, the VAT in respect of outputs (i.e. gross VAT) one immediately arrives at the true basic value, instead of the approximate value, since gross VAT does not only cover the VAT on value added of the respective producer but also the VAT of all the preceding stages, too, for which a corresponding amount of VAT has been charged and deducted successively.

Deducting from the same basis VAT payable only one arrives at an approximate valuation:

(5) gross output at producers' prices (gross treatment/modified gross treatment)
-VAT payable by the producer
=gross output at approximate basic values (in respect of VAT)

In the case of a gross treatment with approximate basic valuation one will encounter difficulties: In order to be able to decompose output at producers' values, including VAT, into output at approximate basic values and VAT payable some information would be required on how much VAT is included in the individual commodity outputs at least if production comprises characteristic and non-

characteristic products[14]. Such information is hardly obtainable through statistical surveys.

As a purposeful compromise a particular VAT-specific concept of basic valuation may be adopted. Referring as far as possible to the SNA concepts the approximate basic value^{x}, net of VAT, may be derived as follows:

(6)

gross (modified gross) treatment	net treatment
gross output at producers' values (gross of VAT)	gross output at producers' values (net of VAT)
-VAT invoiced by the producer	....
-other CT in respect of outputs	-other CT in respect of outputs
=gross output at approximate basic values, net of VAT	=gross output at approximate basic values, net of VAT
-intermediate inputs at purchasers' values (gross of VAT)	-intermediate inputs at purchasers' values (net of deductible VAT)
+deductible VAT on direct intermediate inputs	....
=value added at true basic values	=value added at true basic values
+non-deductible VAT on direct intermediate inputs	+non-deductible VAT on direct intermediate inputs
+other CT on direct intermediate inputs	+other CT on direct intermediate inputs
=value added at approximate basic values^{x} net of VAT	= value added at approximate basic values^{x} net of VAT

14) Only in the rather extreme case when an industry is exclusively producing characteristic products VAT payable could be uniformly deducted from output. Otherwise, the situation is similar to that on the industry x commodity level where the problem of transferring outputs from industries to commodities arises.

This concept of approximate basic valuation[x], net of VAT, is in full accordance with the respective SNA concept as regards CT like VAT without deductibility; on the other hand, it is in similar accordance with the concept of true basic valuation as regards VAT deductible. Apparently this solution turns out as a reasonable approximation to the true basic valuation and seems still feasible with a view to data availability.

No doubt there are many advantages in integrating into the system also that other additional information which enables different variants of analytically useful valuations to be derived. Therewith the next section will deal. In practice the adoption of one of the above variants will, inter alia, depend on which variant itself lends best to the given statistical data basis.

4. The Systematic Framework for VAT Accounts

In the following it is examined how VAT enters into a comprehensive system of Make-(Supply) and Use-Matrices. For this the basic stipulation may be briefly recapitulated once again:

i) Systematical Aspects

- The envisaged accounting system should in principle be in line with the well-known Table 2.1 of SNA and, at the same time, be applicable to VAT. In respect of IO-statistics Table 2.1 shows a system of commodity x industry and industry x commodity accounts.

- The derivation of different IO tables from this "System Table" might be rendered possible according to various analytically useful concepts of valuation (producers' values, approximate basic values, net of VAT). Besides, within the producers' price concept a gross; a modified gross; and a net treatment should be feasible (cf. 3 above).

- The marginal totals of the System Matrix should represent economically meaningfull figures.

ii) Statistical Aspects

- The concept should be reasonably related to the statistical data basis given in Austria : all data required should be obtainable from the primary data sources or at least, not require the availability of the whole system as a precondition.

iii) Functional Aspects

- The peculiarities of the Austrian VAT regime should be appropriately reflected.

Combining the above conditions with the basic options of valuation presented in SNA several different concepts result that are discussed in more detail below. For this instead of complicated verbal explanation extensive use of charts is made. Commodity accounts (goods and services), industry (producers) accounts and corresponding VAT accounts are distinguished.

In substance the resulting System Table differs from Table 2.1 of the SNA only in that it exhibits not only commodity but also the production accounts separated from the corresponding CT (VAT) accounts. This separation enables the distinction to be made between "transitory" deductible invoiced VAT and cost relevant non-deductible VAT. Deductible VAT is a component of the account "VAT (and other CT) on producers' inputs/outputs". Non-deductible VAT on intermediate use is entered in the account "Producers inputs/outputs at approximate basic values, net of VAT".

Subsequent to the System Table the different variants of valuation derived from this matrix are portrayed, as well as symbols used for submatrices, vectors and marginal totals briefly listed.

To illustrate the statistical situation in Austria with a view to VAT a further summary table is added which shows the values actually observed. Supply and use, obviously, may not balance in this framework.

SYSTEM-TABLE

11 12 13 14 15 16 21 22 23 24 25 26 31 32 33 34 35 36 41 42 43 44 45 46 51 52 53 54 55 56 61 62 63 64 65 71 72 73 74 75

		supply at approximate basic value net of VAT	VAT on supply			other CT on supply	producers' inputs at approximate basic values net of VAT	VAT and other CT on producers' inputs	Vat on imports	other import duties	consumption	gross capital formation	imports	
11 Market goods 12 Trade margins 13 Transport margins 14 Services } Market goods 15 other goods and services 16 services produced for own use } non-market goods	use at approximate basic values net of VAT						U_b				C_b	F_b	X_t	q_t
21 Market goods 22 Trade margins 23 Transport margins 24 Services } Market goods 25 other goods and services 26 services produced for own use } non-market goods	VAT on use							U_v			C_v	F_v		v
31 Market goods 32 Trade margins 33 Transport margins 34 Services } Market goods 35 other goods and services 36 services produced for own use } non-market goods	non deductible VAT on intermediate use						U_x	$-U_x$						$\emptyset$
41 Market goods 42 Trade margins 43 Transport margins 44 Services } Market goods 45 other goods and services 46 services produced for own use } non-market goods	deductible VAT on gross capital formation							F_y				$-F_y$		$\emptyset$
51 Market goods 52 Trade margins 53 Transport margins 54 Services } Market goods 55 other goods and services 56 services produced for own use } non-market goods	other CT on use						U_c				C_c	F_c	X_c	c
61 62 63 } industries 64 producers' of other goods and services 65 producers' of government services	producers output at approximate basic values net of VAT	V_b												q_b
71 72 73 } industries 74 producers' of other goods and services 75 producers' of government services	VAT and other CT on producers' outputs		V_v			V_c								t
VAT on imports } import duties s			m_v											r
other import duties } import duties s						m_c								s
Imports cif (net of import duties)		m_h												
primary inputs (factor costs)							y_f							
non commodity taxes							y_t							
VAT payable by the producers' incl. VAT on imports								y_v	-					
other commodity taxes incl. other import duties								y_c		s				
		q'_b	v'	$\emptyset$	$\emptyset$	c'	q_b	t'	r	s				

<u>Producers' value</u>

"gross treatment"

	supply at producers' values including VAT	producers' Inputs at producers' values including VAT	VAT on imports	other import duties	Consumption at producers' values	gross capital formation at producers' values, incl. VAT	Exports	Σ
Use at producers' values including VAT		$U_b+U_v+U_c$			$C_b + C_v + C_c$	$F_b+F_v+F_c$	$X_b + X_c$	q_g
Producers' outputs at producers' values including VAT	$V_b+V_v+V_c$							g_g
VAT on imports	m_v							r
other import duties	m_c							s
factor costs		y_f						
other indirect taxes		y_t						
VAT payable by the producers on their current transactions incl. VAT on imports		y_z	r					
other commodity taxes incl. other import duties		y_c		s				
imports, cif	m_b							
Σ	q_g'	g_g'	r	s				

$$y_z = Y_v + (i.F_y) = (V_v.i)' - (i.(U_v-U_x))$$

PRODUCERS' VALUES

"modified gross treatment"

	supply at producers values excluding deductible VAT on gross capital formation	producers' inputs at producers' values inclusive VAT	(neg.)deduct.VAT on gross cap.form.	VAT on imports	other import duties	Consumption at producers'values	gross capital formation at producers' values excl. deductible VAT	Exports	$\sum$
Use at producers'values excluding deductible VAT on gross capital formation		$U_b+U_v+U_c$				$C_b + C_v + C_c$	$F_b+(F_v-F_y)+F_c$	$X_b + X_c$	q_m
Producers' outputs at producers'values including VAT	$V_b+V_v+V_c$								g_m
(neg.)deductible VAt on gross cap.f.	$-f_y$								$-z$
VAT on imports	m_v								r
other import duties	m_c								s
factor costs		y_f							
other indirect taxes		y_t							
VAT payable by the producers' incl: VAT on imports		y_z	$-z$	r					
other commodity taxes incl. other import duties		y_c			m_s				
imports,cif	m_b								
$\sum$	q_m'	g_m'	$-z$	r	s				

$$f_y = (F_y \cdot i)'$$

$$z = f_y \cdot i$$

Producers'values "net treatment"	Supply, at producers' values (including non-deductible VAT)	producers' inputs at producers' values (net of VAT)	VAT levied on products	other import duties	consumption at producers' values	gross capital formation at producers' values (incl. non-deductible VAT)	Exports	$\sum$
Use at producers' values (including non-deductible VAT)		$U_b + U_x + U_c$			$C_b + C_v + C_c$	$F_b + (F_v - F_y) + F_c$	$X_b + X_c$	q_n
Producers' outputs at producers' values (net of VAT)	$V_b + V_c$							g_n
VAT levied on products	d_v							1
other import duties	m_c							s
factor costs		Y_f						
other indirect taxes		Y_t						
VAT payable by the producers = VAT levied on products			1					
other commodity taxes incl. other import duties		Y_c		s				
imports, cif	m_b							
$\sum$	q_n'	g_n'	1	s				

$d_v = (U_x . i + C_v . i + (F_v - F_y) i)'$

$1 = d_v . i$

$s = m_c . i$

' .... transposed

i .... summation vector

approximate basic values, net of VAT

	Supply outputs at approximate basic values net of VAT	Producers' Inputs at approximate basic values net of VAT	Consumption	gross capital formation	Exports	Σ
Use at approximate basic values net of VAT		U_b	C_b	F_b	$x_{.b}$	q_b
Producers' outputs at approximate basic values net of VAT	V_b					g_b
factor costs		y_f				
other indirect taxes		y_t				
non deductible VAT levied on direct intermediate inputs		iU_x				
other CT levied on direct intermediate inputs		iU_c				
Imports, cif	m_b					
Σ	q_b'	g_b'				

Submatrices of "observed" values

	supply of commodities	producers inputs	VAT on imports	other import duties	consumption	gross fixed capital formation: purchases	gross fixed capital formation: own account	Additions to stocks: input	Additions to stocks: merchandise	Additions to stocks: output	exports
use of commodities		$U_b+U_c+U_x$			$C_b+C_v+C_c$	$F_b^1+F_c^1+(F_v^1-F_y^1)$	F_b^2	$F_b^3+F_c^3$	$F_b^4+F_c^4$	F_b^5	X_b+X_c
producers outputs	$V_b + V_c$										
	m_y										
	m_c										
	m_b										
GDP net of VAT and import d.		$y_f+y_t+y_c$									
VAT on imports			r								
other import duties				s							

Descriptions and Definitions of Matrices (Vectors) and Marginal Totals

m_b.........Imports cif
V_b.........Outputs at approximate basic values net of VAT
U_b.........Intermediate use at approximate basic values net of VAT
C_b.........Consumption at approximate basic values net of VAT
F_b.........Gross capital formation at approximate basic values net of VAT
X_b.........Exports at approximate basic values net of VAT

m_v.........VAT on imports
V_v.........VAT on outputs (VAT invoiced by the producers')
U_v.........Deductible and non-deductible VAT in respect of direct intermediate inputs (VAT invoiced to the producer)
C_v.........VAT on consumption
F_v.........VAT on gross capital formation deductible and non-deductible
U_x.........non-deductible VAT on direct intermediate inputs
F_y.........deductible VAT on gross capital formation
y_f.........Factor costs
y_t.........other (than commodity) indirect taxes
y_v.........VAT payable by the producers[1)] $y_v = (V_v.i)' - (i.(U_v - U_x) + F_y)$
y_z.........VAT payable by the producers on their current transactions[1)] $y_z = y_v + (i.F_y) = (V_v.i)' - (i.(U_v - U_x))$
y_c.........other commodity taxes
m_c.........other import duties
V_c.........other commodity taxes on outputs[2)]

1) For the whole economy VAT payable by the producers includes VAT on imports
2) For the whole economy other commodity taxes include other import duties

U_c.........other commodity taxes on intermediate inputs
C_c.........other commodity taxes on consumption
F_c.........other commodity taxes on gross capital formation
X_c.........Export duties
q_b.........supply (use) at approximate basis values net of VAT
v..........VAT on supply (use)
c..........other commodity taxes and import duties on supply (use)
g_b.........total outputs (inputs) of industries at approx. basic values net of VAT
t..........VAT and other commodity taxes on producers' outputs/ inputs
r..........VAT on imports
s..........other import duties
q_g.........total supply (use) at producers' values (gross treatment) $q_g = q_b + v + c$
g_g.........total outputs (inputs) at producers' values (gross treatment) $g_g = g_b + t$
q_n.........total supply (use) at producers' values (net treatment) $q_n = q_b + c + d_v'$
d_v.........VAT levied on products (by industries) $d_v=(U_x.i + C_v.i + (F_v - F_y)i)$
l..........total VAT levied on products = total VAT payable by the producers $l = d_v.i$
g_n.........total outputs (inputs) at producers' value (net treatment) $g_n=g_b + V_c.i$
q_m.........total supply (use) at producers' values (modified gross treatment) $f_n = f_b+v+c - f_y'$
f_y.........deductible VAT on gross capital formation (by commodities) $f_y = (F_y .i)'$
g_m.........total outputs (inputs) at producers' values (modified gross treatment) $g_m = g_b + t$

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PROBLEMS OF IDENTIFYING AND MEASURING INTERMEDIATE SERVICES IN THE COMPILATION AND USE OF INPUT-OUTPUT TABLES

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A. INTRODUCTION

This paper is mainly concerned with statistical problems relating to intermediate services that arise in the construction of national input-output (I-O) tables. Though these problems are sometimes discussed in the I-O literature, their precise nature is usually not spelled out in any detail and this is done in the paper. The problems are closely related to the classical company-establishment statistical dichotomy permeating the ultimate sources and allocation of intermediate service inputs. We will show that presently used procedures for Canadian and American I-O compilation bear evidence of statistical inconsistencies and lack an appropriate framework to utilize full information. The paper suggests a possible approach for reconciling company and establishment data based on industrial organization linkage analysis at the microdata level. Considerable empirical support is offerred, using official Canadian statistical publications, to show that the suggested approach is both feasible and has desirable properties.

The scope of intermediate (or producer) services covered in this paper is rather limited. In terms of the International Standard Industrial Classification (ISIC), we focus particularly on the commodity services attached to Major Division 8 as described in United Nations [40]. This means that the paper mainly investigates statistical problems relating to: banking and financial services, insurance and real estate operations, computer and information processing services and rentals, advertising and sales promotion activities, and other professional services to business management. In addition, for reasons that will become apparent later, we are also concerned with

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telecommunication services (part of Major Division 7). The industries producing these services can be called producer service industries to the extent that the services are purchased and consumed as intermediate inputs by other industries.

One other important aspect of the paper involves the contemporary information revolution and its implications for I-O compilation and use with special reference to intermediate services. Four major implications are explained in the context of the growing microelectronics technological change literature. At the same time some basic suggestions are put forward with regard to joint-cost allocation and intertemporal comparisons problems with respect to I-O compilation. The paper thus features a somewhat broader view of I-O statistical problems than usual, but, as stated in the conclusion, much more work remains to be done.

B. THE BASIC PROBLEM

First it should be clear that we are primarily concerned with the compilation of input tables (i.e., the use matrix) where a distinction is drawn between intermediate commodity inputs and the industry of use. Now input tables, and the complementary output tables, are compiled by bringing together a wide array of data collections in a double-entry accounting system. There are important commodity balance checks and national income accounting constraints. Generally speaking it seems recognized that the statistical data available from the large variety of sources is more complete and more reliable with respect to intermediate material inputs than with regard to intermediate service inputs. The recent U.S. Department of Commerce GNP Data Improvement Project Report [44] contains a leading recommendation:

> The Census Bureau should collect as an integral part of each economic census the purchases of services by establishments.

This recommendation was strongly endorsed by the National Academy of Sciences Panel To Review Productivity Statistics [18]:

> The Panel endorses the recommendation of the GNP Data Improvement Project calling for the Census Bureau to collect ... data on the purchases of intermediate services as well as materials by establishments.

Since everyone is agreed, what precisely is the problem? Unfortunately, neither of the two references spells out the nature of the difficulty.

We know that I-O tables represent a disaggregated accounting of production. The statistical reporting unit (and tabulating unit) is the establishment. It is desirable that the establishment be sufficiently homogeneous with respect to production (or, its undertaking) to permit classification at a fine level of industrial disaggregation. Given this target, what can we expect the establishment to "report"? The answer to this question essentially depends on industrial organization, ownership and intracompany accounting procedures. We know that the industrial economy of modern nations is dominated by a collection of large corporations or enterprises (both

publically and privately owned) most of which operate "establishments" in a number of different industries.[1] There enterprises, and their constituent companies and divisions, typically do not maintain records in a form which makes it possible for their establishments to report on the full range of production account variables.[2] Hence, in order to maintain the goals of industrial homogeneity and disaggregation, statistical agencies receive and accept less than the full range of production variables from reporting establishments. Generally speaking, the statistical reporting unit must be capable of providing "principal statistics" -- value of output, cost of materials used and data relating to labour employed.[3] In particular, the purchased service inputs (or their indicators), which are the main concern of this paper, are typically not obtained at the establishment-reporting level. These intermediate inputs are usually only known and decided in a more aggregate form somewhere higher up the heirarchy of the multi-establishment (multi-industry) organization. The I-O statistician must obtain the information by methods other than establishment-reporting.

To quote again from the GNP Data Improvement Project Report [44]:

> In the absence of such information, the I-O analyst must allocate the output of a large variety of purchased services among industry subsectors ... These allocations are made on the basis of minimal information from establishments providing the services and with a maximum of judgemental input on the part of the estimator.

Actually this quotation is not entirely fair to the I-O statistician. The fact is that a good deal of ingenuity goes into compiling intermediate service inputs in order to overcome the lack of direct information. Anyone reading the paper by Philip Ritz [24] on the

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1 The evidence, in the Canadian case, will be presented in a later section. There are also problems relating to what is meant by enterprise-ownership or -control, requiring a network (or directed graph) analysis.

2 Briefly, the full range of account variables should be sufficient to calculate "pure value added" from production. See Statistics Canada [32].

3 Value of output less cost of materials used equals "census value added".

1972 U.S. I-O Study could see that![1] Similarly a Canadian I-O Study of the Atlantic Provinces, 1965, by Kari Levitt [14] is a remarkable effort.[2] For example, it is sometimes clear from the detailed nature of an intermediate commodity service output, to which particular industry the service should be allocated as an input. This is illustrated by: architectural services, construction equipment rentals, crop dusting services, natural resource royalty payments, and title abstract insurance. There is also some useful information from the suppliers of producer services which provides guidelines for the industrial input allocations. A good example for Canada is computer processing services and computer equipment leasing, rental and maintenance as seen in the annual publication Statistics Canada [33]. Special periodic surveys could be taken of company headquarters expenditures on intermediate service inputs, but the scope of such surveys is limited and the allocation problem is not resolved in a consistent framework (see next section for further discussion).

The documentation of I-O compilation procedures also reveals another favourite method. There is a tendency to resort to corporation financial statistics or corporation taxation data. For example Ritz [24] deploys such sources to indicate the distribution of both actual and imputed financial service charges. Levitt [14] does likewise, although the financial indicator used is different. It is also possible to directly examine corporation accounting records and on that basis approximate intermediate service inputs. This appears to have been done for various Canadian industries (as inferred from Statistics Canada [34]). The use of corporation accounting and financial data is of great importance for the purpose of this paper and we will have much more to say on the subject in a later section. For the moment it must be stressed that the I-O compilation procedures mentioned in this paragraph do not take systematic account of the multi-industry multi-establishment nature of enterprise or corporation source data.[3] Thus the procedures are only valid for

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1 To be perfectly fair, the Ritz study was not available at the time of the GNP Data Improvement Project.

2 See also the I-O source data documentation in Statistics Canada [34].

3 The multi-industry corporation is completely industrially classified according to the single industry where the corporation has more operations as compared to any other single industry.

industries dominated by legal entities operating in single industry classifications, or we must accept I-O tables with a crude level of industrial disaggregation. In this paper it is assumed that we wish to construct and exploit the potential of highly disaggregated I-O compilations. We also consider that the industrial economy is dominated by a collection of large corporations or enterprises of the type mentioned earlier. In particular, production and financial data gathered from small single industry companies cannot provide accurate guidelines for estimating intermediate service inputs for industries dominated by large multi-industry multi-establishment corporations.

There is one other important aspect of intermediate service input estimation procedures. Given a total output of a particular producer service, the output is often proportionally allocated to industrial users on the basis of a "principal statistic" available for establishments comprising the industries. For example, Ritz [24] distributes part of telecommunication services on the basis of "number of nonproduction employees" and a similar method is used to allocate most of professional services to business management (including the service output of nonprofit trade associations). The combination of "principal statistics" from establishments and "financial statistics" from companies could be a powerful tool for compilation purposes as we shall try to show later.

C. THE VIEW FROM INDUSTRIAL ORGANIZATION

This section surveys the opportunities and problems involved in utilizing an industrial organization approach to I-O compilation (at least with respect to producer service inputs). The viewpoint has been influenced by an early paper by Bartels and Fürst [3] stressing the essential institutional background and policy potential of national accounts including I-O tables. The present writer was also impressed by the work of a team of Canadian economists (see Gigantes et al [7]) dealing with interrelationships between construction of operational models and data possibilities. The work contains far-reaching recommendations concerning business information systems and appropriate data strategy. Nevertheless the viewpoint of this section is more modest. Our scope is limited largely to statistical data that are already available or can be made available after some further tabulations. One other observation can be stated. It is remarkable that the two economic research areas of input-output analysis and industrial organization were both developed at Harvard University during the 1930s (by Wassily Leontief and E.S. Mason respectively). The two fields deal with industrial structure and performance and often use a similar vocabulary. Yet the two research areas have led almost entirely separate existences. This writer has been able to find only one research study[1] that embodies in a substantive way the methodological traditions of both input-output and industrial organization. Perhaps the time has arrived for further studies of that nature.

C.1. Background Documentation

From the development given so far in this paper, it should be clear that there is a role for company- or corporation-based data for the purposes of I-O compilation. The main task is to carefully define and limit this role, but at the same time, provide for further extensions. Indeed, the particular producer services with which we are mainly concerned are on the borderline between establishment-based

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1 The study referred to is a recent Harvard University Ph.D thesis by A. Lemelin [11].

production account statistics and company-based financial and income-outlay account statistics. Consider, for example, the expenses of financing capital formation such as floatation costs for loans -- this is one of the financial producer service inputs. So are broker's commissions -- a transfer service cost with respect to transactions in land and financial claims (as defined in United Nations [42]). It has already been seen that royalties (strictly speaking, an income from property) are often closely related to certain managerial and technical services. Net rents for the use of land are also supposed to be included in income from property, but we know that such payments are often difficult to distinguish from rents for buildings and even heavy machinery. Similarly there is the perennial problem of when long-term leases "become" purchases of machinery and equipment. In fact one of the most important producer service inputs must be imputed, namely the imputed service charges of commercial banks and other financial institutions. The statistical data required to perform the imputation come directly from income and outlay accounts. The situation is very similar with respect to the imputed service charge for casualty insurance. Thus it appears that the producer services discussed in this paper are a vital connection for purposes of statistical integration. Our main interest, however, is elsewhere.

The first question is whether adequate data are available at the company- or corporation-based reporting level to either measure producer service inputs at this level or provide an indicator of the producer service inputs. We must remember that corporation-based data cannot be suitably classified at fine degrees of industrial disaggregation, particularly for the large multi-industry corporations (discussed below). Therefore we must initially consider corporation microdata. The Canadian annual publication [37] on corporation financial statistics is based on financial statements filed by corporations for income tax purposes and represents some 360,000 corporations (in the year 1978). Included are joint ventures of participating corporations, all public and private corporations, and all provincial, federal and municipally-owned corporations. The coverage is virtually complete for most sectors of the economy except for those where unincorporated businesses are significant (agriculture, forestry, fishing, some retail trade and some services). Note that consolidated financial statements for groups of corporations under common ownership or control (enterprises) are not acceptable in Canada.

Corporation financial data contain detailed income and retained earnings statistics. For our purposes we are mainly interested in the breakout of services expenses,[1] namely: rent expense for land and building (including leased real estate), rent expense for machinery and equipment (including leased machinery and equipment), royalties, management and technical fees, advertising and sales promotion costs, casualty insurance premium payments, and commission expenses paid to financial institutions. In addition we need an indicator of the imputed service charges of commercial banks. Ritz [24] uses cash deposits held:[2]

> on the assumption that the largest depositors were the chief beneficiaries of the services for which these charges were an imputed payment.

This indicator (cash deposits held) can be obtained from detailed balance sheet statistics of the Canadian corporation financial data publication. Levitt [14] uses as an indicator:

> the allocation was made roughly on the basis of estimated interest payments and the size of bank loans,

which are originally reported in the detailed income and retained earnings statistics (interest payments) and the detailed balance sheet statistics (bank loans). Thus it appears that most producer service inputs with which this paper is concerned can be obtained directly or indirectly from corporation financial statistics at the microdata level. It is assumed that an official I-O compilation procedure need not worry about confidentiality restrictions, but there certainly are real problems of feasibility and reconciliation to which we now turn.

In the Canadian case, we are not calling for complete examination of all 360,000 corporations. Attention can be focused only on the largest corporations. The best available Canadian data measure the dominating role of the leading corporate <u>enterprises</u> rather than the

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1 Service expenses are supposed to be reported gross rather than net.

2 It is not clear how Ritz reconciles this company-based statistic with the establishment-based operation of I-O compilation. A similar remark applies to Levitt. See discussion below for our suggested reconciliation based on a microdata approach.

individual corporate units. The following statistics for the leading Canadian enterprises are based on straight aggregation (not consolidation) of the affiliated individual corporation financial data. We know (from Statistics Canada [36]) that the leading 500 Canadian[1] enterprises, consisting of some 3,500 individual corporations, account for almost 55 per cent of total sales by all Canadian non-financial corporations in the year 1978. (Financial holding companies are eliminated to avoid double-counting.) The percentage of total sales accounted for by these same enterprises reaches 85 per cent for the mining sector and about 70 per cent for both manufacturing and utilities. Thus it is sufficiently revealing to submit only the corporations classified to the leading 500 enterprises for detailed examination.[2] Moreover, Canadian industrial organization is such that not much is gained by going, say, to the leading 1,000 enterprises (composed of some 4,500 individual corporations). The coverage of total sales increases to about 60 per cent from the original 55 per cent; the coverage of total Canadian assets goes to 70 per cent from the 65 per cent accounted for by the leading 500 enterprises.

The next question is to what extent are the leading Canadian enterprises industrially diversified? This question has been intensively studied for those enterprises based and operating within the Canadian mining and manufacturing sectors (as seen in Statistics Canada [39]). The great majority of the top 500 such enterprises have establishments in more than one four-digit industry group level and many operate establisments in at least five four-digit industries. The multi-industry enterprises among the top 500 alone account for over 60 per cent of total value added in Canadian mining and manufacturing. Furthermore, industrial diversification is not limited to the four-digit level; virtually all the large diversified enterprises are diversified at the two-digit level as well as at the four-digit level. Note that this description grossly underestimates the extent of Canadian industrial diversification since no account is taken of Canadian mining- or manufacturing-based enterprises operating establishments in other sectors of the economy (due to limitations of

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1 This, of course, includes both Canadian- and foreign-controlled enterprises composed of corporations operating in Canada.

2 Note that these corporations are all not necessarily the "leading" corporations; it would be better to deal directly with corporations rather than indirectly through enterprises.

presently available data tabulations).[1] Indeed some of the most diversified Canadian enterprises, officially "based" in manufacturing, are fully integrated oil and natural gas "industries" with establishment activities in: extraction, refining, transportation, storage, wholesaling, retailing, and real estate operations. A good example is the "number three" Canadian industrial corporation Imperial Oil Limited, 69.6 per cent owned by our old friend Exxon Corporation. Before continuing it should be added that there is also considerable evidence regarding the corporate ownership- or control-concentration and industrial diversification patterns inherent in the U.S. economy. The best reference is the work of the industrial organization economist F.M. Scherer [27].

C.2. Towards An Application

After this excursion into the field of industrial organization, we are now prepared to put the "pieces together". How is all this related to the problem of identifying and measuring intermediate service inputs in the compilation of I-O tables? Section B explained the basic problem of this paper -- producer service inputs are generally not observable at the establishment-based[2] reporting unit level essential for highly disaggregated I-O tables. Some very ingenious schemes have been implemented by I-O statisticians to resolve this problem, but there is also evidence of inconsistent use of corporation financial data.[3] We will show that all the ingredients are presently available (at least in Canada) to utilize corporation financial data in a more consistent fashion and that such utilization has desirable "by-product effects". Earlier in this section we saw that corporation-based detailed income statements and balance sheets

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1 A related Statistics Canada publication [38] shows diversification within the overall economy at the one-digit industrial level.

2 We overlook the fact that certain industries are created on a "kind-of-activity" basis such as agriculture and construction. But the problems of producer service input measurement still remain. Much of the exposition in this paper is orientated towards the problems of the manufacturing sector -- where most of I-O industrial disaggregation occurs.

3 Statisticians are, of course, aware of the inconsistencies and therefore tend to deploy corporation data only where "there is nothing else".

contain information directly or indirectly related to intermediate service input charges and expenses. These data must be examined at the microlevel in order to consistently allocate multi-industry corporation statistics to establishment-based units. The link between the two types of reporting units is effected by an establishment-based microdata panel; each member of this data base is assigned a corporation identification code. We also saw that it is sufficiently revealing to limit examination to those establishments identified and operated by the leading corporations of the economy. In the Canadian case, presently available tabulations show the link between establishments and enterprises. Since enterprises are merely collections of closely affiliated corporations and are, by definition, mutually exclusive with respect to establishment composition, it certainly appears possible to retabulate and match establishments with individual corporations.[1]

This still leaves the question of precisely how corporation-based data relating to producer service inputs is to be allocated to the particular establishments (and, therefore, industries) identified with each corporation. Consider the following basic three-step procedure. Suppose a control total (over all industries of the business sector) for a specific intermediate service input is given. We wish to distribute this total to each and every industry of the I-O table. An example might be "professional services to business management". First the control total is allocated to individual corporations in proportion to "management and technical fees" as observed in the corporations' financial statements. Then each corporations' allocation of "business services" is distributed to the establishments identified with each corporation according, say, to the proportion of nonproduction workers in each establishment as compared to all establishments comprising the particular corporation. (One might imagine that own-employed nonproduction workers and purchased business services are complements in production.) The final step is to utilize the classification of establishment units to the individual industries and aggregate the allocations assigned to all establishments of the same industry. Thus a combination of

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1 This was, in fact, done in the early work of John McVey [16] at Statistics Canada. Presently available matching procedures appear to cover about 75 per cent of the total business sector economy with relatively low coverage of industries with significant unincorporated business operations (agriculture, construction, trade and some services).

"principal statistics" from establishments and "financial statistics" from corporations can be deployed for I-O compilation purposes. This suggested procedure has both consistency and full-information properties. A very similar three-step procedure holds for the important case "imputed service charges of commercial banks and other financial institutions". A control total can be allocated to individual corporations according to "size of bank loans" (following Levitt [14]) each of which distributes its imputed bank service charge to component establishments according, say, to the value of their relative contribution to census value added or, perhaps, according to their recent additions to gross output.

A number of brief comments are now in order. The above suggested allocation procedure is very simple. Some more sophisticated cost allocation mechanisms are discussed in the next section of this paper. We recognize that I-O control totals are not just "given", but evolve after appropriate adjustments and refinements. The suggested allocation procedure could easily be made part of an iterative framework (although there is no absolute guarantee of convergence). Another point is that the above procedure neglects "undercoverage" and, in fact, the procedure is only practical working with the leading corporations. (For Canada we would probably need the leading 1,000 corporations measured in terms of total census value added by establishment-based composition.)[1] It will, therefore, be necessary to add a residual "dummy" corporation to the suggested procedure whose multi-industry composition represents all establishments of the economy <u>except</u> those identified with the leading 1,000 corporations. In effect the residual allocation of a producer service input takes no account of the remaining corporation-establishment activity complex and is equivalent, say, to allocating residual "business services" <u>directly</u> to industries according to their relative non-production workers' employment. The direct allocation method alone (used, e.g., in Ritz [24]) will not yield the same results as an allocation method based on the corporation-establishment complex except in very special cases. This leads to the question as to whether the complex relationship between each of the leading corporations and their component establishments (and, therefore, multi- industry composition) must be re-estimated for each I-O table? We know this relationship is affected by corporate mergers,

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1 This should be roughly equivalent to the overall economy coverage of the leading 500 enterprises.

amalgamations, acquisitions, divestitures and even establishments' births and deaths. But the limited evidence available shows[1] that such changes in industrial organization occur gradually and are relatively small. It seems possible to construct base year multi-industry composition coefficient matrices for the leading corporations which can serve as useful approximations for periods of, say, up to five years.[2]

Finally, we consider whether there is any better information available than corporation financial statistics to serve as an intermediary through which the allocation process is channeled. Recent discussions concerning large diversified corporations' line-of-business reporting, or segmented reporting, are relevant (see Scherer [28]). The Canadian Royal Commission on Corporation Concentration [25] has rejected a rigorous line-of-business reporting program that would be useful (if practical) for our purposes. In any event, no such data are presently available on a reasonably comprehensive and systematic basis such as already exist for corporation financial statistics (see also the O.E.C.D. [19] survey). Nevertheless it is desirable to seriously consider future improvements. In effect we need a new type of reporting unit for financial and related information which closely parallels the function of the statistical reporting unit used for "principal production statistics", namely the establishment. The new unit would be the smallest operating entity for which a reasonably complete set of "principal financial statistics" can be obtained (either through direct reporting or standardized allocation methods).[3] Similarly, the new units should be mutually exclusive and exhaustive with respect to their universe. Their operating functions would probably coincide with the division of multi-division companies or with investment centres or profit centres of large corporations that operate on such a basis. However,

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1 See the most recent work of McVey [17] for the situation in Canadian manufacturing and mining.

2 A typical coefficient matrix will be sparse (easy to store) and have dimensions equal to the number of industries (say, 200) and the number of leading corporations (say 1,000). It may be necessary to construct distinct matrices for each and every producer service input commodity which is to be distributed by the suggested procedure.

3 Statistics Canada has considerations along these lines; see Côté [5].

a reading of the Harvard Business Review [23] is enough to note the wide diversity of existing intracorporate structures and practices.

D. THE VIEW FROM TECHNOLOGICAL CHANGE

Like everyone else, the present writer has been swamped by literature portraying the so-called microelectronics revolution (also called the information technology revolution). It is easy to develop nightmares over repeated warnings about the growing convergence of the electronic computer and telecommunications field. Nevertheless the situation is not a joke and, in fact, presents opportunities and problems for input-output compilation and use. The discussion in this section will remain within the sober vocabulary of economics and statistics; we will not be carried away by microelectronics jargon. It should also be added that the following discussion is distinctly more speculative than that of previous sections; so our suggestions should be regarded as tentative

D.1. Background Discussion

The microelectronics technological revolution raises a number of issues relevant to input-output compilation and use. These issues are not really new, but arise in an extreme (and, possibly, exaggerated) form so that one cannot avoid being stimulated towards some basic rethinking of accepted conventions. This paper will not attempt to document the claims and predictions associated with the recent microelectronics and supporting literature. Indeed there is a remarkable consensus in this literature to which the reader is directly referred.[1] Instead we examine the economic implications of present and future supposed technological changes so far as these implications are related to producer services in an I-O context. The emphasis is on identification problems of producer services output.

The first implication of the microelectronics literature is that the service sector of the economy will be most affected. There is emphasis on a diminished role for strictly manufacturing and material

1 The international literature is best illustrated by Kimbel [9], Barron and Curnow [2] and the just released O.E.C.D. [20]. For Canada, Serafini and Andrieu [30] and Rabeau [22] provide good surveys.

production activities as compared to pre- and post-production service activities. In particular, the merging technologies of electronic computer/telecommunications systems impact all service functions related to the creation, collection, manipulation, storage, retrieval, and distribution of information. This raises the question as to whether these service functions are adequately identified in I-O compilations as producer service commodities with corresponding producer service industries? To answer this question it seems appropriate to briefly examine the current state (and even, the historical development) of input-output practice.

We know that input-output is largely oriented towards describing and measuring the phenomenon of industrial interdependence. For example, I-O methods are capable of tracing the processing of natural resources through the fabrication hierarchy of indstrial classification. This applies to both renewable and nonrenewable resources.[1] Considerable effort has been expended trying to determine the fundamental triangulation (or bloc-triangulation) pattern of interindustry transactions. To achieve these goals, special care has been given to the segregation and identification requirements of the traditional primary and secondary intermediate commodity disaggregations. There are, for example, well-known instances where I-O compilation calls for the statistical disintegration of vertically integrated mining-manufacturing establishment units. This is the case for Canadian base metal mining and related smelting and refining. In effect, some intraestablishment (nonmarket) technical relations are "broken-out"[2] to reflect the existence of counterpart market transactions involving other establishments. Similarly there are examples where industries are defined on a strictly activity-basis. This means that if such activities are carried out even as part of the own-account (internal) operations of certain industrial establishments, both the output and corresponding inputs are removed and aggregated together with the industry where the activity is considered primary. The Canadian construction industry, including maintenance and repair construction, is defined on this basis. These cases all involve material commodities and have the effect of raising aggregate recorded gross

1 See Postner [21] for I-O measurements of "initial processing" and "additional processing" of Canadian natural resources in an international trade context.

2 Sometimes referred to as "raising new establishments".

output.[1] One might say that I-O practice is biased towards the "double-counting" (and, therefore, exhibited interindustry connections) of material goods at various stages of their fabrication. The present writer suspects that this bias is a vestige of the Material Products System (MPS) even though our examples come from the System of National Accounts (SNA). The fact is that I-O empirical applications rarely display "interesting" utilization of the producer service industries. The latters' role is essentially passive, usually supporting production in the nonservice industries. True, there are commodity transactions between individual producer service industries, but these transactions lack a directional hierarchy. Whoever heard of a primary service commodity undergoing "further processing"?

Such is the state-of-the-art as it exists today. There is, however, reason to believe that if I-O is to remain relevant to future economic problems, then special care must be extended to the segregation and identification of producer services. Consider an example in the spirit of the microelectronics technological change literature. The well-known Ruggles and Ruggles text [26] contains the statement:

> There has been a growing tendency to pull administrative and research personnel out of the establishment and centralize them. The computer and modern communications systems permit accounting, design specification, customer relations, billing, and even payroll to be done by the central office.

This statement is confirmed by empirical evidence. Moreover, a case study of the effects of informatics on a large corporate head office in Canada (see Menzies [15]) is also consistent with this general theme. We know that the producer service functions of multi-establishment corporate head offices are typically not segregated and identified for I-O compilation purposes; the functions are considered internal and integrated with the corporations' principal activity (often one of the manufacturing industries). Yet the microelectronics revolution is also permitting the relatively small single-industry and single-establishment companies to contract-out

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1 Total national income is, of course, unaffected by the manipulations required for I-O practice. Also note that the issues discussed here lie beyond the problem of whether a constant industry technology assumption or a constant commodity technology assumption (or some mixture) is best to combine estimated make and use matrices.

their (formerly internal) administrative, overhead, and related business financial services requirements.[1] Thus reasonably counterpart market prices for head office producer service functions are becoming available together with estimates of their input structure.[2] It would seem both desirable and possible to "break-out" head office producer service functions as explicit producer service commodities.

A second major implication of microelectronics technological change is the creation of entirely new producer services (without previous counterparts either internal or external). With the advent of computerized records and related communications, the problem of encoding to preserve secrecy has become commercially important. All the applications such as electronic mail, electronic funds transfer, and even corporations' computer-conveyed memos between headquarters, require new and sophisticated encryption services. Another example comes from Telidon -- the Canadian-designed videotex system (that uses a telephone line to hook a television set to distant computers and memory banks, turning the television screen into a video display terminal). One of the most interesting applications of this system concerns the dissemination of the specialized business services information provided by nonprofit trade associations.[3] But first the information must be appropriately packaged and managed by a new kind of software service. Finally, in Canada, certain natural resource corporations are subject to federal guidelines before applying for federal financial aid. The guidelines concern the extent of the corporations' Canadian-resident ownership. In response, a major financial trust company has developed a computer system to measure, on a daily basis, the changing Canadian ownership rate (by tracking daily purchases on the stock market) of any corporation that subscribes to its service. Since these examples all embody entirely new producer services, they cannot consistently be aggregated with any existing classification of service commodities.[4]

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1 This will be discussed again later when considering the impact of technological change on deposit-taking institutions.

2 There are certainly allocation problems here; see discussion to follow.

3 See the description in De Melto et al [6]; data on associations can be found in Statistics Canada [31].

4 The next subsection contains some suggestions relating to the problem of intertemporal comparisons.

A third important implication is that technological change is resulting in an erosion of traditional industrial classification boundaries. The prime example comes from the computerization of deposit-taking institutions.[1] Chartered banks and some near-banks in Canada now offer a wide variety of computer-conveyed business and financial services: bookkeeping (telaccount), account reconciliation, payroll accounting, billing and accounts receivable, accounts payable and pre-authorized debiting, cash consolidation and funds transfer plans, as well as advisory and management services. In effect, the large chartered banks have turned their in-house computer departments into quasi-independent profit centres that offer data processing services to their outside customers. The large Canadian insurance companies appear to be playing a similar game. Another example concerns the videotex suppliers' market mentioned earlier: a virtual "melting pot" of the telecommunications industry (including common carriers, broadcasters and cable companies), the computer data processing industry (both hardware and software), and the information service industry providers (mostly financial institutions, advertisers, publishers and retailers). And in the future, we will be hearing much more about electronic funds transfer systems (EFTS): a clearing network of pre-authorized debit-credit accounts with remote service or point-of-sale characteristics. The system can only work with at least some integration of activities presently characterizing financial institutions, telecommunications carriers, computer processors and manufacturers, and potential business users of EFTS.

One way input-output is supposed to handle problems of the above nature is by permitting industrial establishments to produce secondary commodities and, indeed, commodities could greatly outnumber industries. The trends outlined in the preceding paragraph undermine traditional industrial homogeneity ratios, but it may seem that this could be overcome by more liberal use of specific redefinition schemes (as done in Ritz [24]).[2] Such schemes, however, cannot clarify industrial cost structures if the output of major industries are completely confounded by "secondary" commodities and if it is not initially certain to which industry a commodity should be assigned as

1 Our references include Binhammer and Williams [4] and Lambie [10].

2 Implicitly, the Ritz scheme deploys the constant commodity technology assumption. This assumption, strictly speaking, requires that the number of commodities equal the number of industries.

"primary". Thus the need arises for distinct cost structures for individual producer service commodities in a given classification as originating from individual industries in a corresponding classification. This information requires the development of official accounting guidelines. To quote, for example, from Binhammer and Williams [4]:

> Banks were asked to ensure that their accounting procedures properly allocate all costs and revenues between their banking operations and computer services offered their customers and that these be available for inspection ...

Some recent innovations in accounting allocation procedures will be mentioned in the next subsection. If, however, the computer services of commercial banks become a major aspect of their operations, it would then seem desirable to "segregate-out" all such secondary computer services activities (both internal and external) and aggregate with the computer service industry where this activity is considered primary. Such a procedure is analogous to the present treatment of all construction activities.[1] On the other hand, the problems of de-integrating an EFTS complex of activities (analogous to the disintegration of base metal mining-smelting-refining) raise issues that probably cannot be resolved in the traditional I-O industrial classification format.

A fourth (and final) economic implication of the microelectronics revolution, including computer-telecommunications convergence, concerns the need for government regulation of industrial standards, ownership, rate structure and accessibility. There is also the well-known fear of increased invasion of privacy as larger volumes of information become available in computer files. The United Nations SNA [42] take the view that:

> Government units engaged in providing services of a regulatory character ... are not to be considered industries though the payments for these services may cover the full current costs of operating the agencies. These payments ... are not considered to be purchases of services.

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1 Ritz [24] refers to this as "carving up" establishments.

This view is questionable and may result in a significant underestimation of important producer services in the future.[1] According to some microelectronics experts, it may become difficult to distinguish government licensing and regulation from government participation with private enterprise (in joint ventures and consortia) with respect to the operation of major national and international computer-telecommunications networks.

D.2. Some Basic Suggestions

This subsection contains some basic suggestions that appear relevant to the problems of I-O compilation when examined from the viewpoint of future technological changes.

At a number of points in this paper, issues were raised that, directly or indirectly, touch on the well-known problem of common-cost allocation. Indeed, the whole of Section C, together with the suggested three-step allocation procedure, is partly concerned with this matter. The purchased producer services of large multi-industry corporations are one important component of the corporations' common-cost overhead and must be allocated to individual establishments for I-O compilation purposes. In this section the issue is a little different; we are concerned with individual establishments (e.g., a chartered bank) producing two or more commodities (e.g., banking services and data processing services). We need to allocate all costs, including all common costs, between the various commodity operations.[2] There is reason to believe that recent and future technological changes will magnify the importance of problems of this nature. This problem is nothing new and, in fact, is perfectly familiar to the company accountant. What is new is that accountants are now experimenting with sophisticated joint cost allocation procedures based on axiomatic game-theoretic percepts. The literature goes considerably beyond the well-known Shapley value solution

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1 If these activities are not classified as an industry, then the services will not be accounted for as commodities in input-output compilation. See, also, discussion in Kimbel [9].

2 This problem also arises in a line-of-business reporting program; see Scherer [28].

of n-person co-operate games.[1] It is even possible to derive, from first principles, some of the accountants' traditional allocation rules in special cases. Indeed these experiments are closely related to current economic research in the areas of cross-subsidization, economies of scope, and public utility pricing. It is, therefore, suggested that economic statisticians be aware of these developments in order to better understand the implicit bases of generally accepted (or seemingly arbitrary) common-cost allocation procedures.

The spectre of revolutionary technological change raises the question as to whether it will be possible to perform intertemporal comparisons of input-output tables. After all, there are entirely new producer services becoming available, traditional industry classification boundaries are increasingly blurred, and there is need to modify and "break-out" the treatment of some other important categories of producer services. This, supposedly, calls for revised methods of constructing I-O tables and, indeed, the 1972 U.S. I-O table is difficult to compare with the previous 1967 table.[2] The originator of input-output, Wassily Leontief, would not appear to worry about this lack of comparability, because with the utmost frankness he says [12]:

> Comparativism as a method of scientific inquiry is greatly overrated. In economic research, particularly of a quantitative kind, it offers convenient refuge to unimaginative minds. If one is at a loss in finding an effective analytical interpretation of a given set of facts, it is always possible to compare, particularly if one is ready to disregard destinations. But after the comparison is completed, what next? Too often one turns to the comparison of something else.

Aside from the notion that Professor Leontief's views on this subject may lead to unemployment among economists, the present writer believes that comparativism of input-output tables can be defended along <u>two</u> lines. First, e.g., consider a productivity growth study based on input-output analysis. We may wish to use the study for

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1 A good survey of game theory is Schotter and Schwödiauer [29]. Recent applications in accounting can be found in Jensen [8] and Balachandran and Ramakrishnan [1].

2 There are both classification and methodological differences; see Ritz [24].

policy-projection or -prediction purposes. In order to discover where the economy (or productivity) is going, we must first learn where the economy is presently situated. Since the study is concerned with economic change, it is also desirable to learn how the economy arrived at its present situation. This would provide a basis for possibly changing the direction of where the economy is going and requires intertemporal comparisons. However, the second argument, to follow, is much more important.

Anyone who reads Professor Leontief's article from which the above quotation is taken will realize that conventional intertemporal comparativism is replete with pitfalls. In fact this whole section of our paper is devoted to showing that recent and prospective technological changes call for some profound industrial classification and statistical methodological modifications with respect to I-O compilation. Can anything be salvaged? The answer is: Yes! It is possible to perform economically meaningful intertemporal I-O comparative analysis even though the various compilations are subject to important modifications. In fact the technique for doing precisely this kind of analysis is a simple generalization of Leontief's ingenious method of double inversion [13].[1] Consider three I-O tables, each 5 years apart in time, namely: 1967, 1972 and 1977. It is then possible to perform a double inversion comparison of the 1967 and 1972 tables on the basis of that subset of industries and commodities which the two tables have directly in common. Remember that all industries and commodities in both years, including "incomparable" magnitudes, are fully taken into account by the double inversion procedure. Similarly it is possible to perform a double inversion comparison of the 1972 and 1977 tables on the basis of their directly comparable industries and commodities. Thus the years 1967 and 1972 are subject to a comparative I-O analysis; the years 1972 and 1977 are also subject to the same analysis; all this even though the I-O tables for 1967 and 1977 may have very little in common! In an extreme case, the years 1967 and 1977 may have nothing in common if the two subsets of 1972 I-O industries and commodities,

1 Leontief [13] works directly with industry x industry tables. But the double inversion technique is also applicable to combinations of make and use tables under either the constant industry technology assumption or the constant commodity technology assumption. Full applicability of the technique, however, does require that the make matrix satisfy certain reasonable conditions concerning the relationship of directly comparable commodities to directly comparable industries.

used as directly comparable basis with 1967 and 1977 respectively, are mutually exclusive. In other words it is possible to achieve substantive intertemporal comparative analysis of input-output tables without assuming (or forcing) transitivity. Indeed, transitivity is not essential for intertemporal comparativism. Since this is the case, the compilers of I-O tables should feel free to introduce the necessary classification and methodological modifications with each new table and not feel bound to maintain an artificial complete and transitive comparability. The users of I-O tables should not be seduced by long time series of I-O tables that are supposed to be perfectly comparable. The double inversion procedure, when fully understood, can also be utilized to provide guidelines concerning how and when the essential modifications could be gradually introduced while preserving a large measure of (intransitive) direct comparability.

E. CONCLUSION

The paper has developed certain aspects of national input-output compilation and use that do not appear to be sufficiently emphasized in the I-O literature. However, it should also be clear that even after this exposition, some important points still remain under-developed. The purpose of the conclusion section is to briefly mention these points which require further investigation.

First, as stated in Section B, the paper is primarily concerned with the compilation of input tables (the use matrix) rather than output tables (the make matrix)[1] though some aspects of the latter are implicit in the discussion of Section D (see, e.g., the very brief treatment of head offices in that section). It is true that the most interesting statistical issues arise with respect to the input tables, but the I-O coverage of this paper is essentially incomplete. Any improvement in the compilation of input tables with special respect to producer services must also be reflected, to a certain extent, in the compilation of the complementary output tables. The two sets of tables are, of course, related by commodity and industry balance checks within a national income accounting framework.

Second, there are some profound statistical difficulties in "exactly" matching corporation-based financial statements with establishment-based production data even at the corresponding microdata level which are not spelled out in this paper. In some cases we may need to be satisfied with "approximation" matching procedures. A good deal depends upon whether corporation statements are of the consolidated type and whether business establishment registration files are always kept up-to-date. More discussions of this issue is called for.

Third, the previous section made note of some new common-cost allocation mechanisms based on game-theoretic precepts. In principle these mechanisms should be a significant improvement over, e.g., the simple proportional allocation procedures described in Section C of this paper. Unfortunately the new mechanisms are not yet operational and their use is limited to experimental situations and academic discussions. Nevertheless there is reason to believe that circumstances

1 The present writer wishes to thank Josef Richter for stressing this point in his comments on the original version of this paper.

are changing; the development of computer-driven management information systems (MIS) and their potential linkage with government data collection systems conceptually permits very sophisticated statistical procedures to be utilized in the compilation of both I-O tables and other areas of national accounts. Therefore it is felt that the brief discussion in this paper is a beginning rather than an end.

Finally, at a number of places in this paper, technical issues were raised that might be illustrated by mathematical formulations and representations. Nevertheless the given development is entirely non-mathematical and even introductory in purpose and scope. There is no doubt that a more advanced treatment requires an excursion into the field of, what is becoming known as, mathematical accounting. In effect the paper is indirectly dealing with subtle problems of second-order statistical integration and reconciliation. This really calls for explicit matrix transformations between alternative systems of classification and statistical reporting based on mathematical analysis of materials coming from carefully designed matching and linkage investigations. Moreover the information technology revolution points to the need for periodic updating of such transformations, or the need to consider higher-order transformations in a more general context.

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